Prairie Climate Centre

# *Climate Resilient Food Systems in the Greater Golden Horseshoe Region*

## Ontario Climate Change Symposium 2016

May 5, 2016 Guelph, Ontario

---

The University of Winnipeg

IISD
International Institute for Sustainable Development

# Acknowledgements

Prairie Climate Centre

# About Us

Prairie Climate Centre

## Dr. Danny Blair

- Scientific Director, Prairie Climate Centre
- Climatologist
- Associate Dean, Faculty of Science
- Principal, Richardson College for the Environment
- Professor, Department of Geography
- University of Winnipeg

## Dr. Ian Mauro

- Communications Director, Prairie Climate Centre
- Film maker, environmental scientist
- Associate Professor, Department of Geography
- University of Winnipeg

## Ryan Smith, MSc

- Research Associate, Prairie Climate Centre
- Climate researcher, computer programmer and map designer
- University of Winnipeg

## Dr. Hank Venema

- Planning Director, Prairie Climate Centre
- Policy analyst, International Institute for Sustainable Development
- Professional engineer
- Climate, water, energy, ecosystem management, environmental economics, agriculture policy expert

# *Our Mission*

Prairie Climate Centre

The **mission** of the Prairie Climate Centre follows three strategic goals:

- *Climate Data and Research* – data and research that address critical knowledge gaps, facilitate adaptation planning, and generate solutions across the Prairie Provinces.

- *Communication and Outreach* – deploying video, mapping and other multi-media tools to mobilize knowledge tailored to the needs of different stakeholder groups.

- *Planning and Development* – Leading adaptation at local, regional and national scales, ensuring a new generation of leaders, and long-term vitality of the Prairie Climate Centre through strategic partnerships and constant innovation

# *Why ? History*

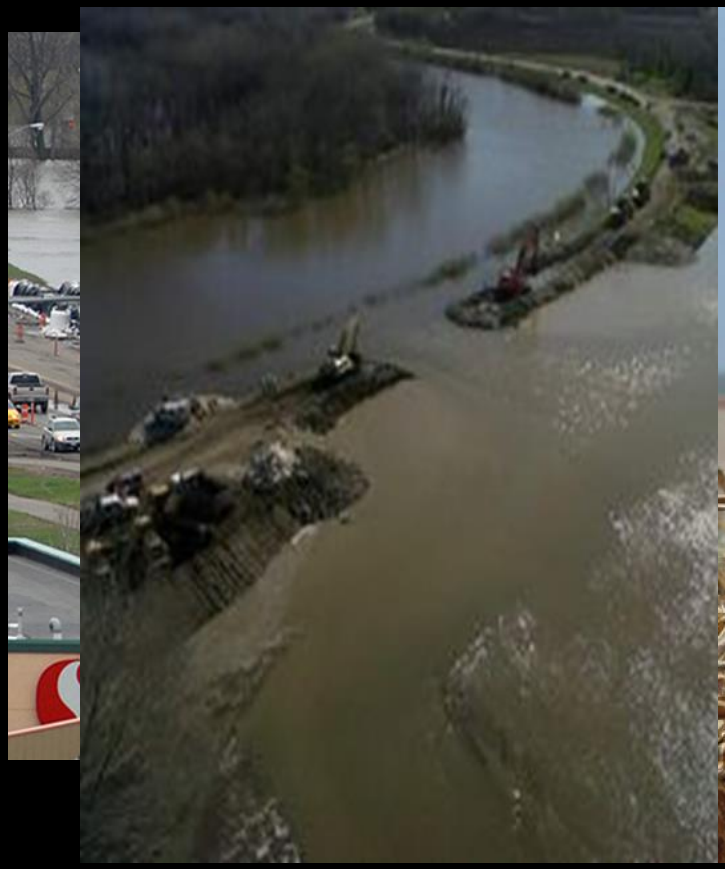
Prairie Climate Centre

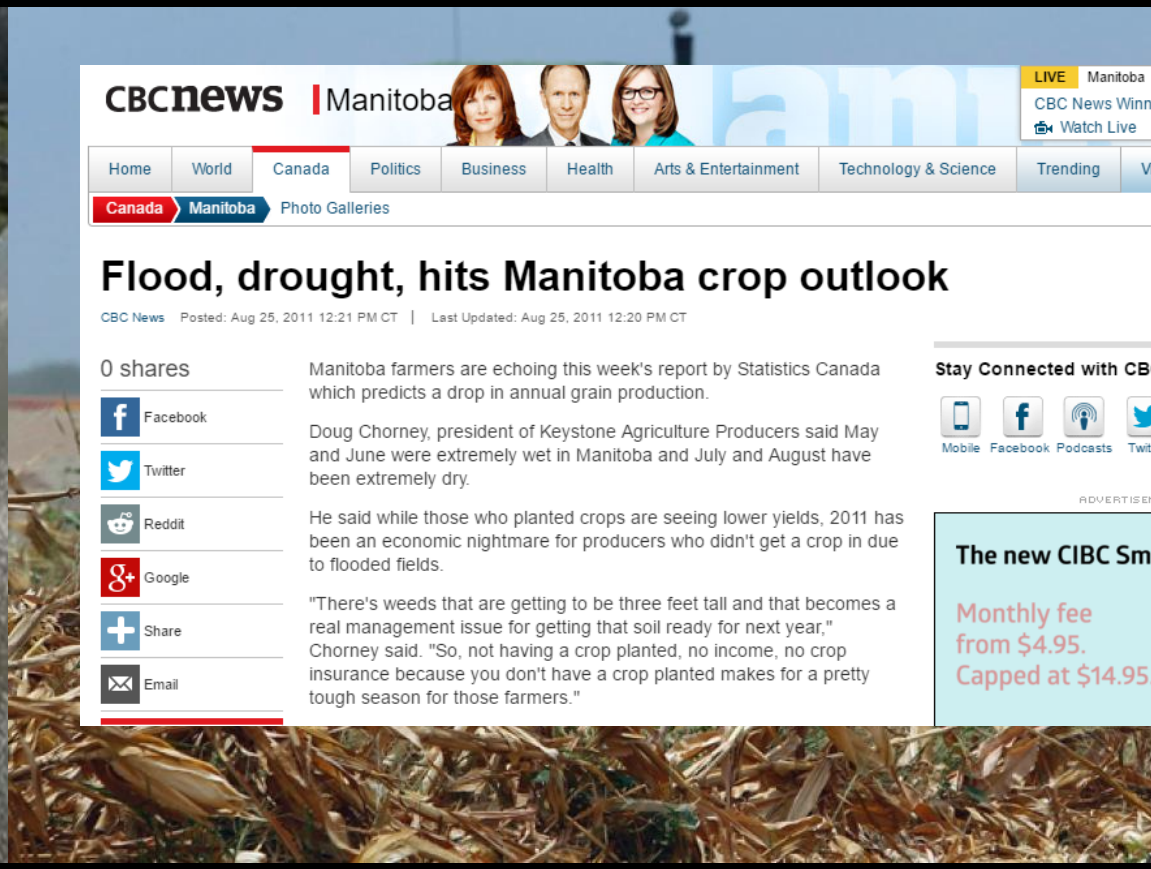
- 1950 Red River Flood
- 1997 Red River Flood
- 2011 Assiniboine River Flood (and Drought)
  - *"geopolitically destabilizing"*


N
Lake
Winnipeg
Lake Manitoba
Winnipeg
R.
Lockport
River
Portage
Diversion
Portage
La Prairie
Winnipeg
St. Norbert
Red River
Floodway
La Salle R.
River
CANADA
U.S.A.

# 2011 "Weather Whiplash"

Prairie Climate Centre





CBCnews | Manitoba

LIVE Manitoba
CBC News Winn
Watch Live

Home | World | Canada | Politics | Business | Health | Arts & Entertainment | Technology & Science | Trending

Canada | Manitoba | Photo Galleries

## Flood, drought, hits Manitoba crop outlook

CBC News Posted: Aug 25, 2011 12:21 PM CT | Last Updated: Aug 25, 2011 12:20 PM CT

0 shares

Facebook
Twitter
Reddit
Google
Share
Email

Manitoba farmers are echoing this week's report by Statistics Canada which predicts a drop in annual grain production.

Doug Chorney, president of Keystone Agriculture Producers said May and June were extremely wet in Manitoba and July and August have been extremely dry.

He said while those who planted crops are seeing lower yields, 2011 has been an economic nightmare for producers who didn't get a crop in due to flooded fields.

"There's weeds that are getting to be three feet tall and that becomes a real management issue for getting that soil ready for next year," Chorney said. "So, not having a crop planted, no income, no crop insurance because you don't have a crop planted makes for a pretty tough season for those farmers."

Stay Connected with CB

Mobile Facebook Podcasts Twit

ADVERTISE

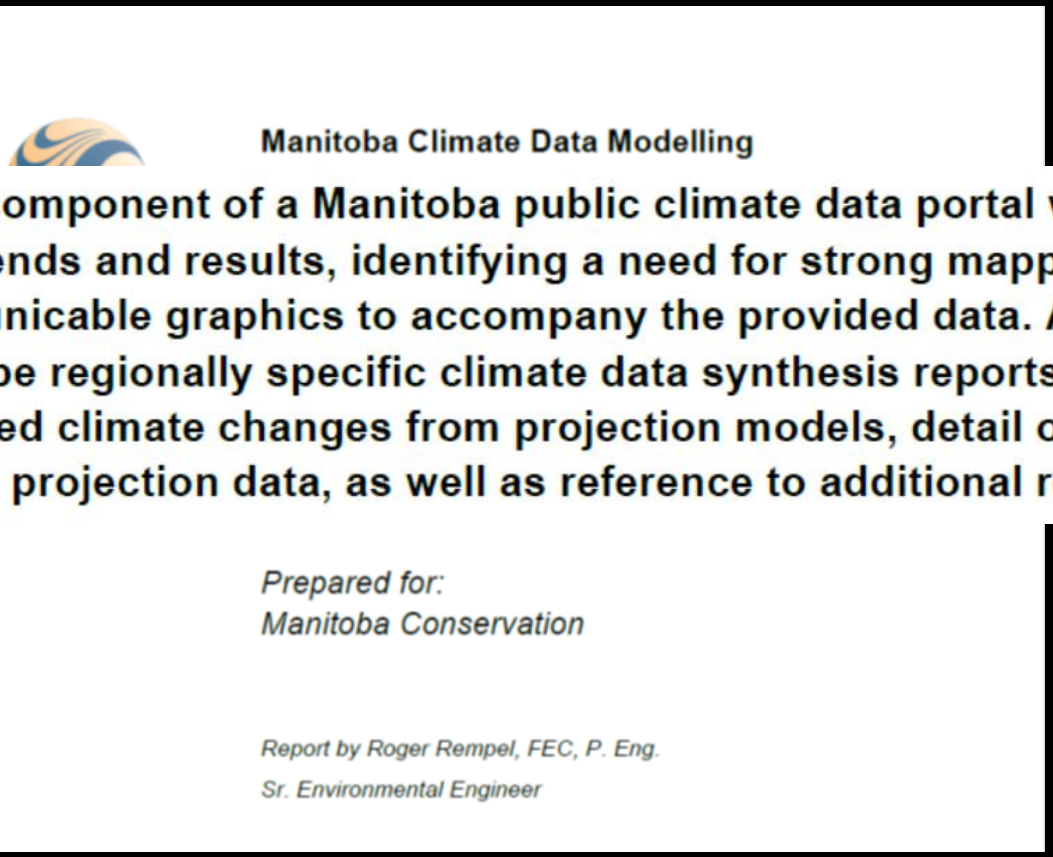
The new CIBC Sm

Monthly fee
from $4.95.
Capped at $14.95

# *Needs Identified*

Prairie Climate Centre

## climate impact information translation for risk management



Manitoba Climate Data Modelling

**A key component of a Manitoba public climate data portal would be communication of data trends and results, identifying a need for strong mapping products and highly communicable graphics to accompany the provided data. A complement to the mapping would be regionally specific climate data synthesis reports discussing the envelopes of predicted climate changes from projection models, detail on limitations for using the climate projection data, as well as reference to additional resources for data support.**

*Prepared for:*
*Manitoba Conservation*

*Report by Roger Rempel, FEC, P. Eng.*
*Sr. Environmental Engineer*

# Job #1
# Prairie Climate Centre
# Prairie Climate Atlas

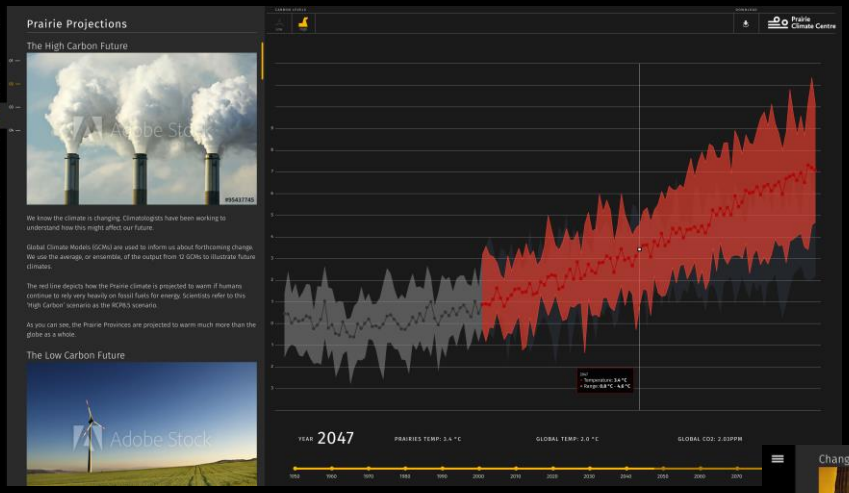
Visualizing Climate Change Projections for the
Canadian Prairie Provinces

---

Prairie
Climate Centre

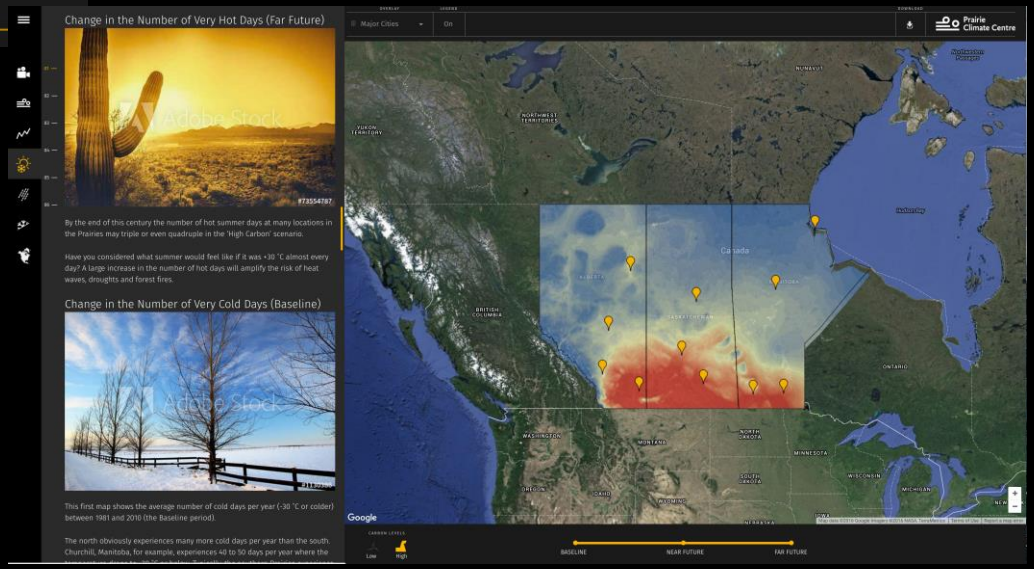
# Interactive Atlas

Prairie Climate Centre




2047: $2^0$ Globally = $3.4^0$ in Prairies

Spatial Documentary Video



# Outline

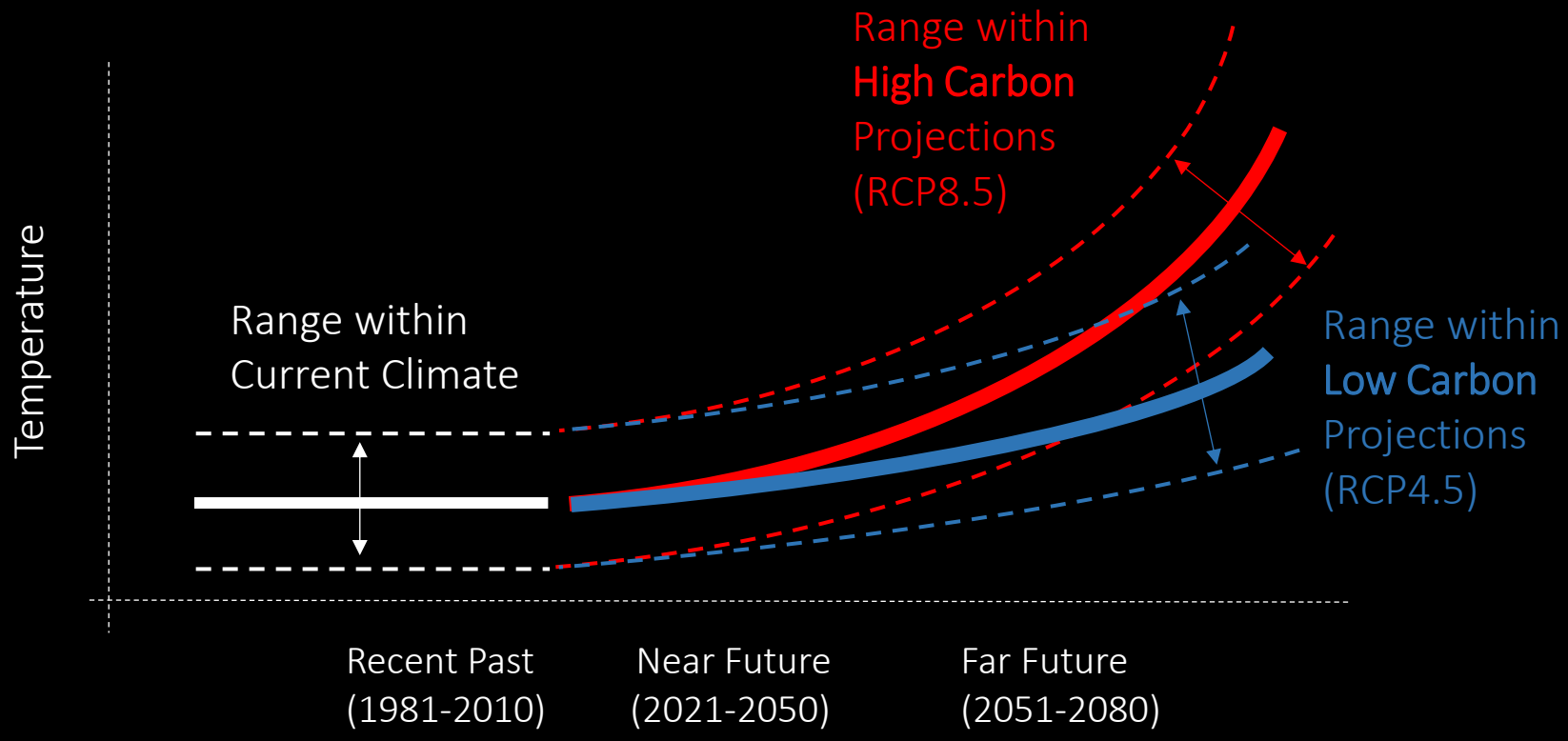
Prairie Climate Centre

- We use data from 12 downscaled global climate models to produce ensemble (average) projected conditions for the region
- Downscaled data was produced by the Pacific Climate Impacts Consortium (PCIC) in Victoria, BC
- For any location/area in the Prairie Provinces (e.g., town, RM, crop district) we can provide a detailed summary of the projected climate changes
- Projections using two Carbon Emissions Scenarios are used to represent the uncertainty associated with future concentrations of greenhouse gases
- Projections are shown for two future time periods: near future (2021-2050) and far future (2051-2080). Changes often shown relative to 1981-2010 baseline period (modeled).

# Projections Summary

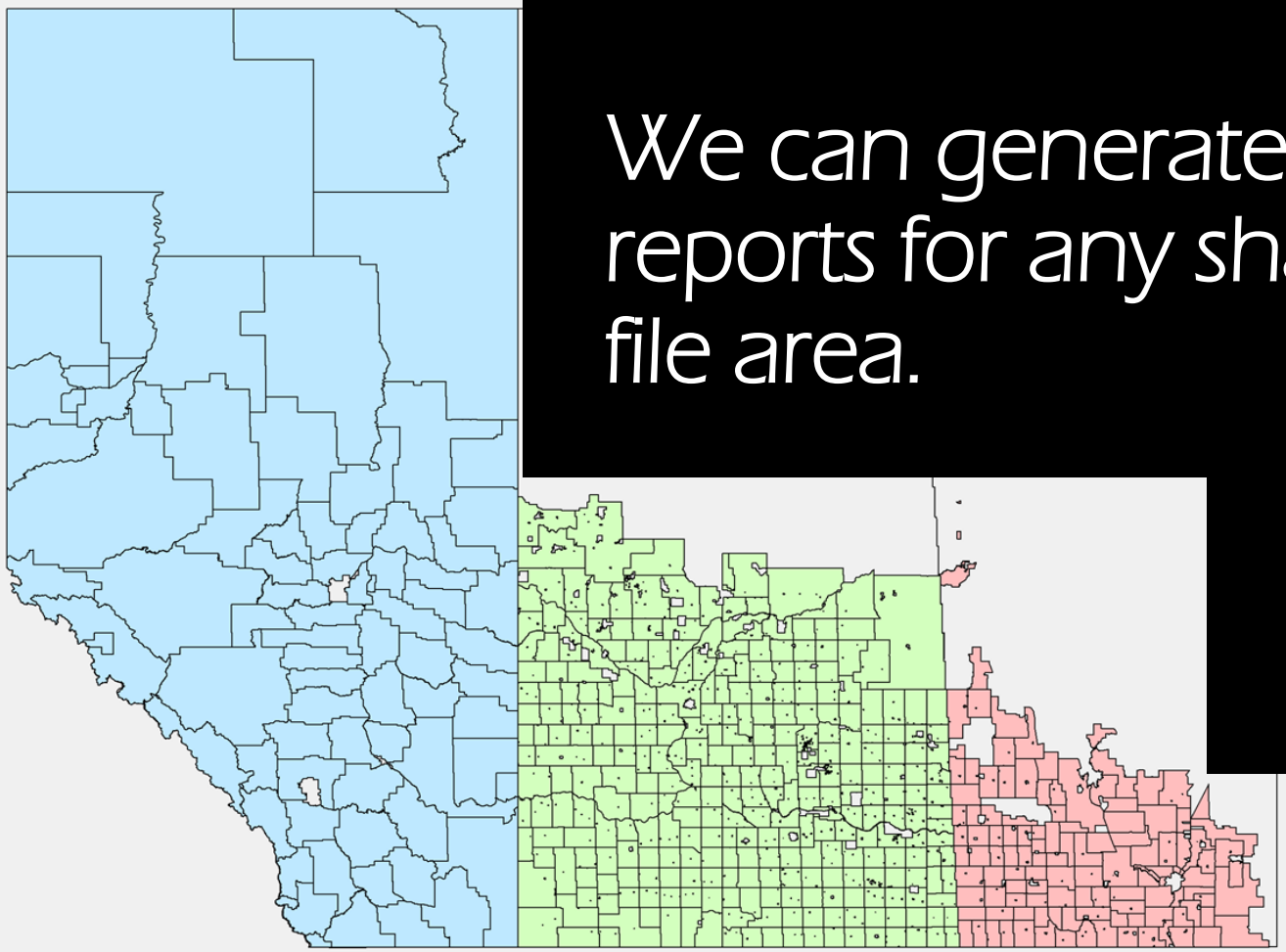
Prairie Climate Centre

- Climate projections were extracted from:
  - 12 Global Climate Models, each using
  - 2 Carbon Emissions Scenarios (RCP4.5 and RCP8.5)



# Tailor-made Reports

Prairie Climate Centre



We can generate reports for any shape-file area.

# Tailor-made Reports

Prairie Climate Centre

## Winnipeg

### High Carbon Emissions (RCP8.5)

Prairie Climate Centre
From Risk to Resilience

| Climate Variable | Season | 1981-2010 (Baseline) | 2021-2050 L | 2021-2050 M | 2021-2050 H | 2021-2050 +/- | 2051-2080 L | 2051-2080 M | 2051-2080 H | 2051-2080 +/- |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Projections | | | | Projections | | | |
| **Days ≥ 30 °C** | Annual | 11.0 days | 19.0 days | 25.6 days | 36.0 days | +14.6 days | 34.0 days | 46.4 days | 60.0 days | +35.4 days |
| **Nights ≥ 20 °C** | Annual | 1.0 days | 2.0 days | 5.1 days | 9.0 days | +4.1 days | 10.0 days | 15.8 days | 22.0 days | +14.8 days |
| **Days ≤ -30 °C** | Annual | 8.2 days | 1.0 days | 2.9 days | 5.0 days | -5.3 days | 0.0 days | 0.7 days | 2.0 days | -7.5 days |
| Last Spring Frost | - | May-19 | May-02 | May-11 | May-20 | -8 days | Apr-24 | May-02 | May-11 | -17 days |
| Frost-Free Period | Annual | 128.4 days | 128.0 days | 145.8 days | 162.0 days | +17.4 days | 147.0 days | 161.4 days | 177.0 days | +33.1 days |
| First Fall Frost | - | Sep-24 | Sep-23 | Oct-04 | Oct-19 | +9 days | Oct-02 | Oct-10 | Oct-22 | +16 days |
| Frost Period | Annual | 211.2 days | 150.0 days | 165.2 days | 178.0 days | -45.9 days | 145.0 days | 157.7 days | 174.0 days | -53.5 days |
| Frost Days | Annual | 186.2 days | 157.0 days | 167.0 days | 179.0 days | -19.2 days | 134.0 days | 148.2 days | 159.0 days | -38.0 days |
| Icing Days | Annual | 117.8 days | 92.0 days | 104.2 days | 115.0 days | -13.6 days | 71.0 days | 86.7 days | 98.0 days | -31.1 days |
| Freeze-Thaw Cycles | Annual | 58.7 cycles | 45.0 cycles | 54.1 cycles | 61.0 cycles | -4.6 cycles | 46.0 cycles | 53.1 cycles | 58.0 cycles | -5.6 cycles |
| 5 °C Degree Days | Annual | 1826.1 | 2086.9 | 2188.9 | 2314.7 | +362.9 | 2402.5 | 2601.5 | 2807.6 | +775.4 |
| 10 °C Degree Days | Annual | 1015.7 | 1225.9 | 1301.6 | 1401.8 | +285.9 | 1490.1 | 1640.7 | 1823.2 | +624.9 |
| 16 °C Degree Days | Annual | 325.6 | 453.3 | 506.1 | 563.1 | +180.5 | 641.9 | 748.8 | 881.4 | +423.2 |
| Max 1-day Precip | Annual | 67.0 mm | 54.7 mm | 75.3 mm | 99.2 mm | +12.5 % | 50.9 mm | 77.4 mm | 108.6 mm | +15.6 % |
| Max 3-day Precip | Annual | 139.9 mm | 118.2 mm | 160.4 mm | 198.4 mm | +14.6 % | 102.8 mm | 168.3 mm | 226.8 mm | +20.3 % |
| PET | Annual | 632.2 mm | 658.7 mm | 672.3 mm | 684.1 mm | +6.3 % | 689.1 mm | 714.1 mm | 737.1 mm | +12.9 % |
| P:PET Ratio | Annual | 0.83 | 0.76 | 0.82 | 0.88 | -0.01 | 0.74 | 0.79 | 0.83 | -0.04 |

L = Low Projection (10th Percentile)  M = Mean Projection  H = High Projection (90th Percentile)

# Days -30° or Colder

# Shifting Extremes

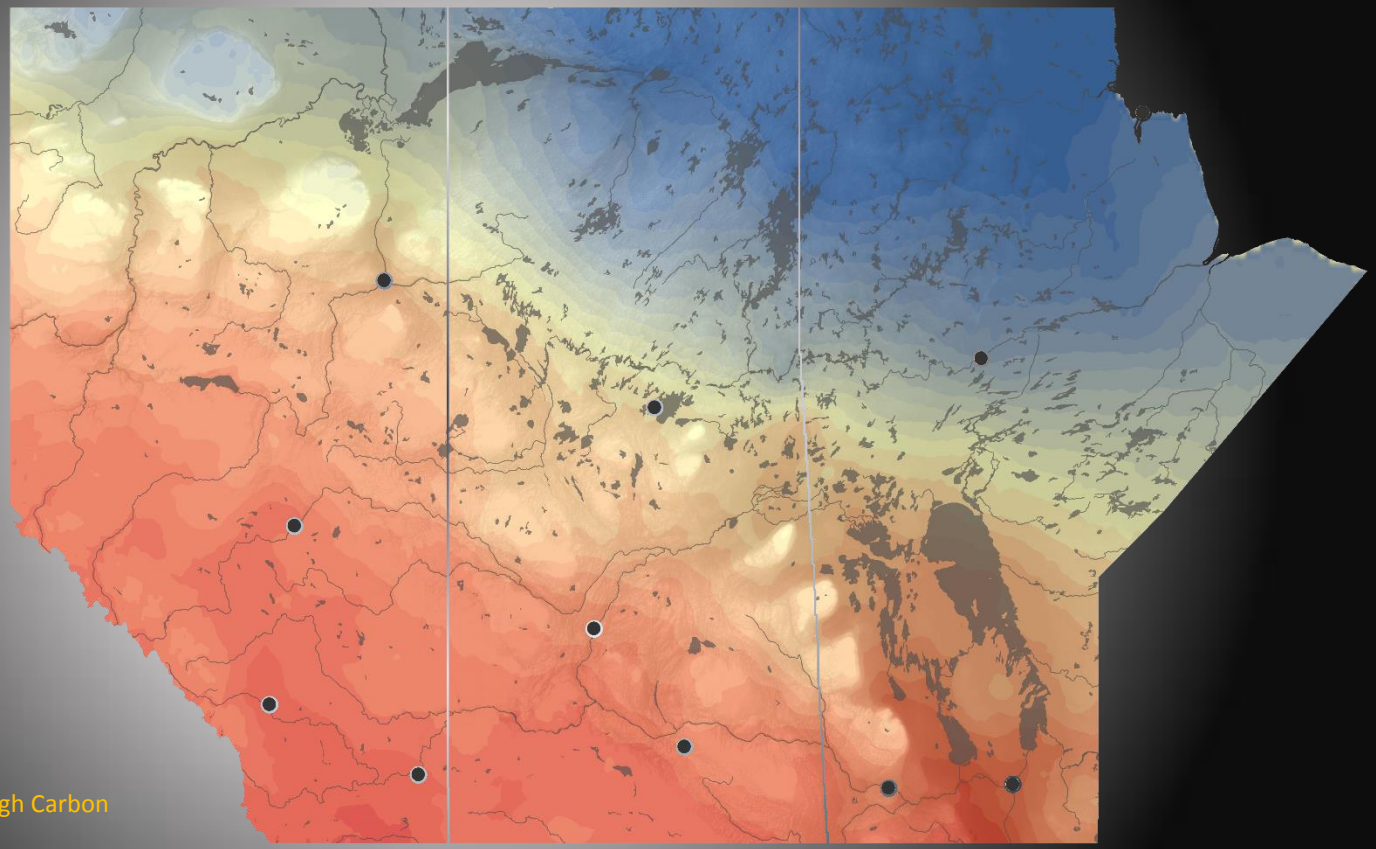
*Change in the Number of Very Cold Days*

Prairie Climate Centre

This is the type of image that will be on our website.

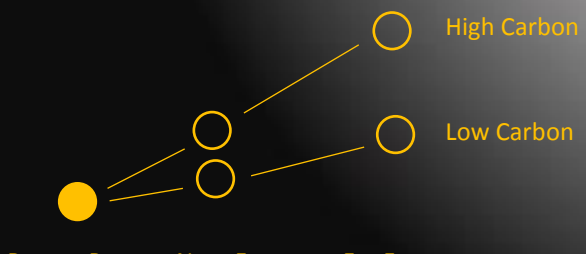
Draped over scalable Google Earth images.

Major centres will be clickable, to obtain data details.



**1981-2010** Annual number of days ≤ -30 °C

48+ 44 40 36 32 28 24 20 16 12 8 4 0




Data Source: Pacific Climate Impacts Consortium (PCIC), University of Victoria, (2014). Statistically Downscaled Climate Scenarios. Downloaded from pacificclimate.org.

# Shifting Extremes

*Change in the Number of Very Cold Days*

Prairie Climate Centre

Five different versions of maps for each variable will be presented:

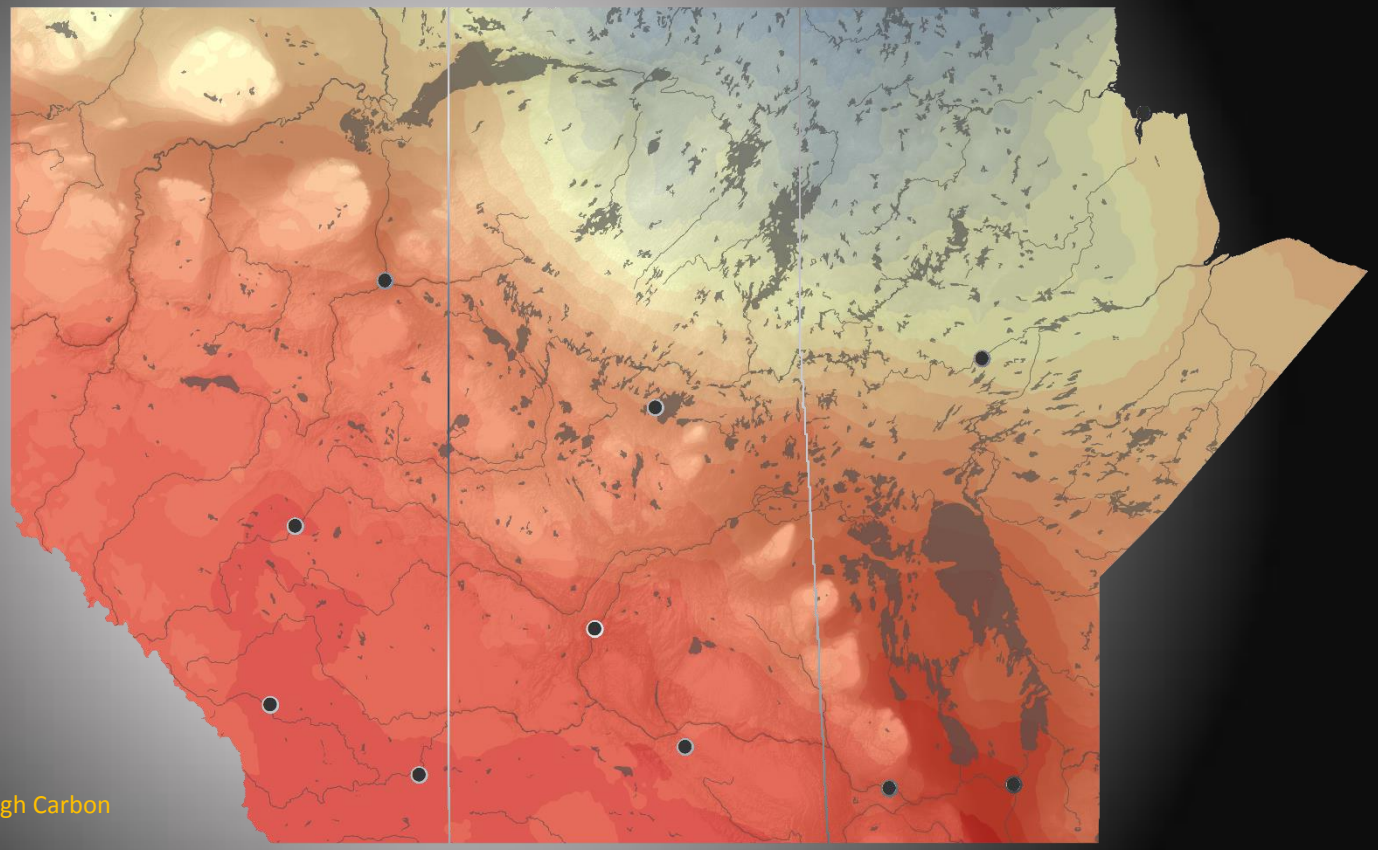
1981-2010

2021-2050 (RCP4.5)

2021-2050 (RCP8.5)

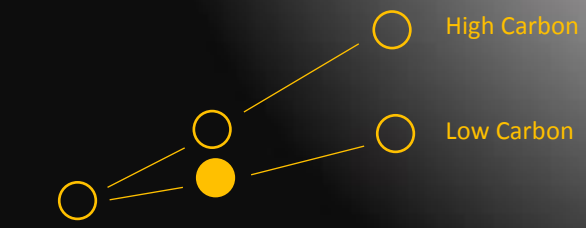
2051-2080 (RCP4.5)

2051-2080 (RCP8.5)



**2021-2050** Annual number of days ≤ -30 °C

48+ 44 40 36 32 28 24 20 16 12 8 4 0

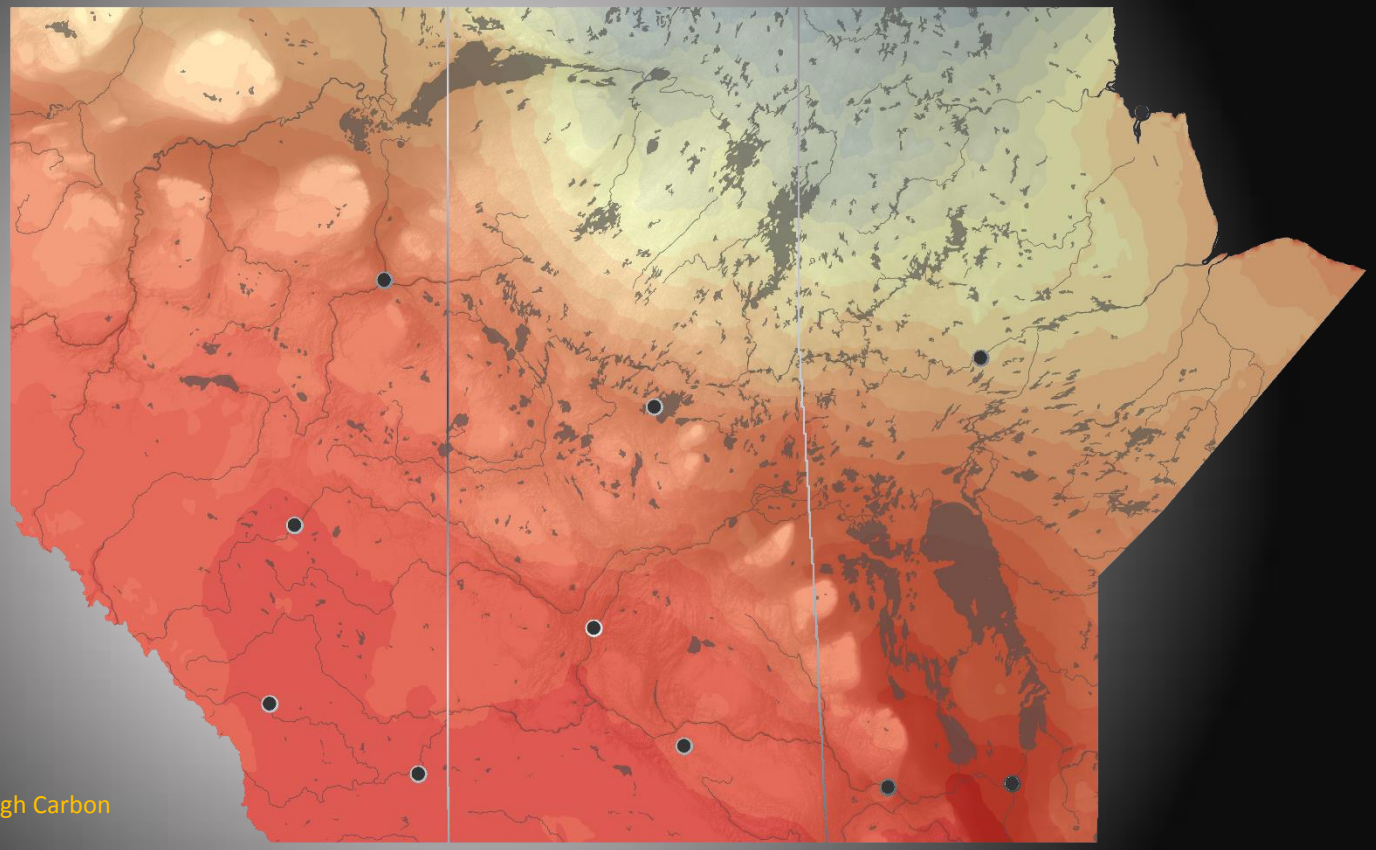



Data Source: Pacific Climate Impacts Consortium (PCIC), University of Victoria, (2014). Statistically Downscaled Climate Scenarios. Downloaded from pacificclimate.org.

# Shifting Extremes

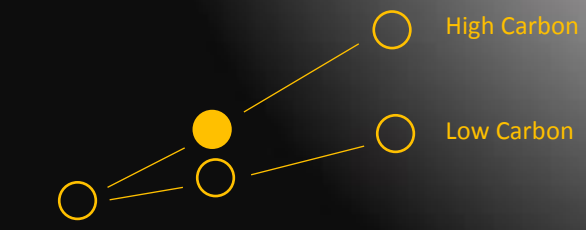
*Change in the Number of Very Cold Days*

Prairie Climate Centre



**2021-2050** Annual number of days ≤ -30 °C

48+ 44 40 36 32 28 24 20 16 12 8 4 0

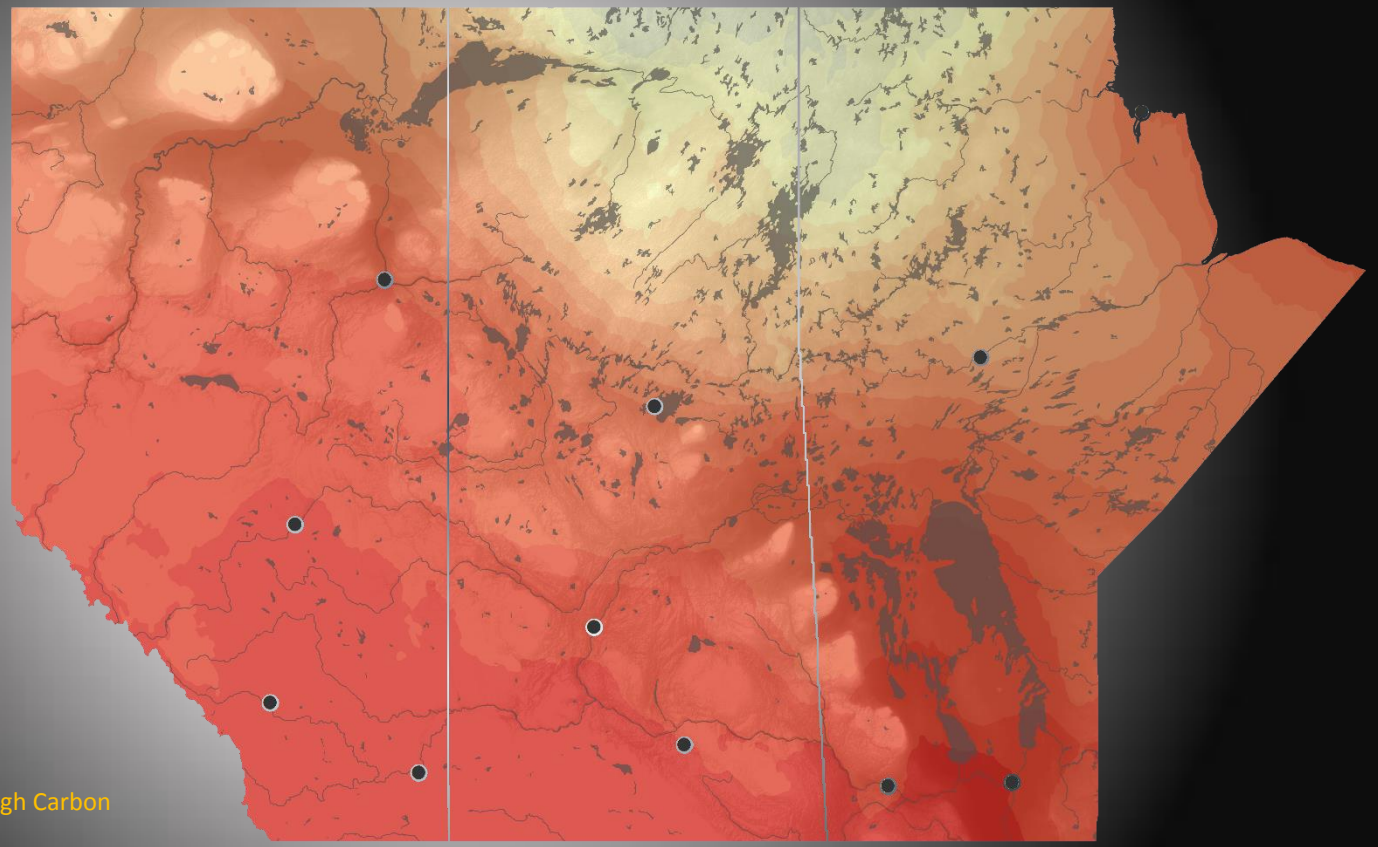



Data Source: Pacific Climate Impacts Consortium (PCIC), University of Victoria, (2014). Statistically Downscaled Climate Scenarios. Downloaded from pacificclimate.org.

# Shifting Extremes

*Change in the Number of Very Cold Days*

Prairie Climate Centre



**2051-2080** Annual number of days ≤ -30 °C

48+ 44 40 36 32 28 24 20 16 12 8 4 0

High Carbon

Low Carbon

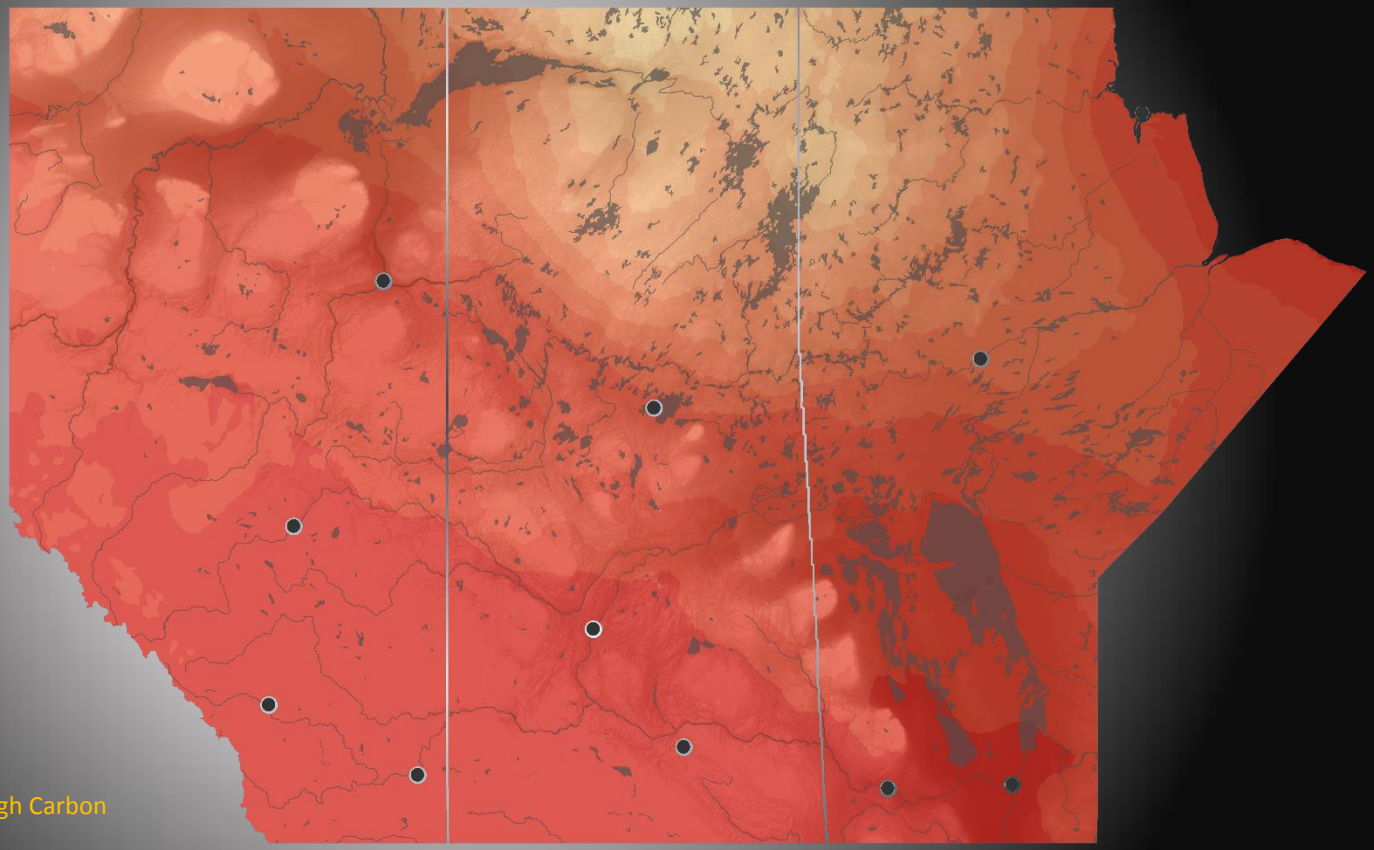
Recent Past Near Future Far Future

Data Source: Pacific Climate Impacts Consortium (PCIC), University of Victoria, (2014). Statistically Downscaled Climate Scenarios. Downloaded from pacificclimate.org.

# Shifting Extremes

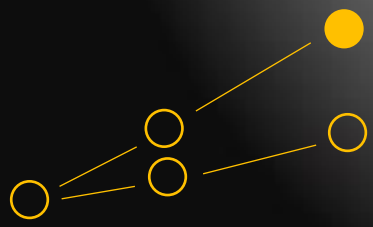
*Change in the Number of Very Cold Days*

Prairie Climate Centre



**2051-2080** Annual number of days ≤ -30 °C

48+ 44 40 36 32 28 24 20 16 12 8 4 0



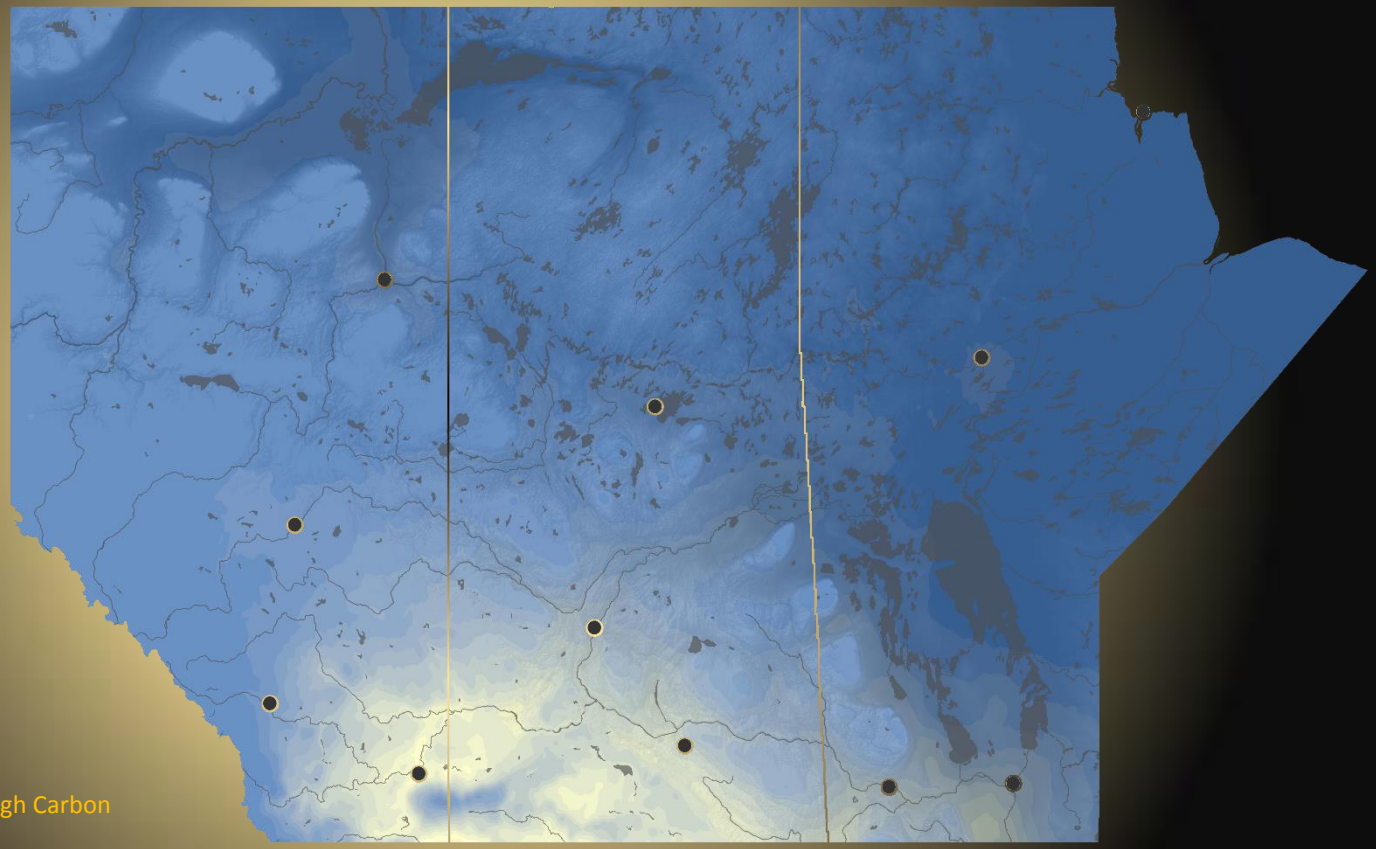

Data Source: Pacific Climate Impacts Consortium (PCIC), University of Victoria, (2014). Statistically Downscaled Climate Scenarios. Downloaded from pacificclimate.org.

# Days +30°
# or Warmer

# Shifting Extremes

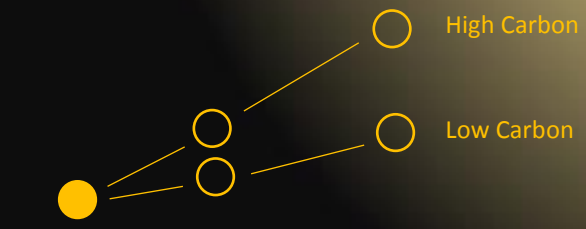
*Change in the Number of Very Hot Days*

Prairie Climate Centre



**1981-2010** Annual number of days ≥ 30 °C

0 4 8 12 16 20 24 28 32 36 40 44 48+

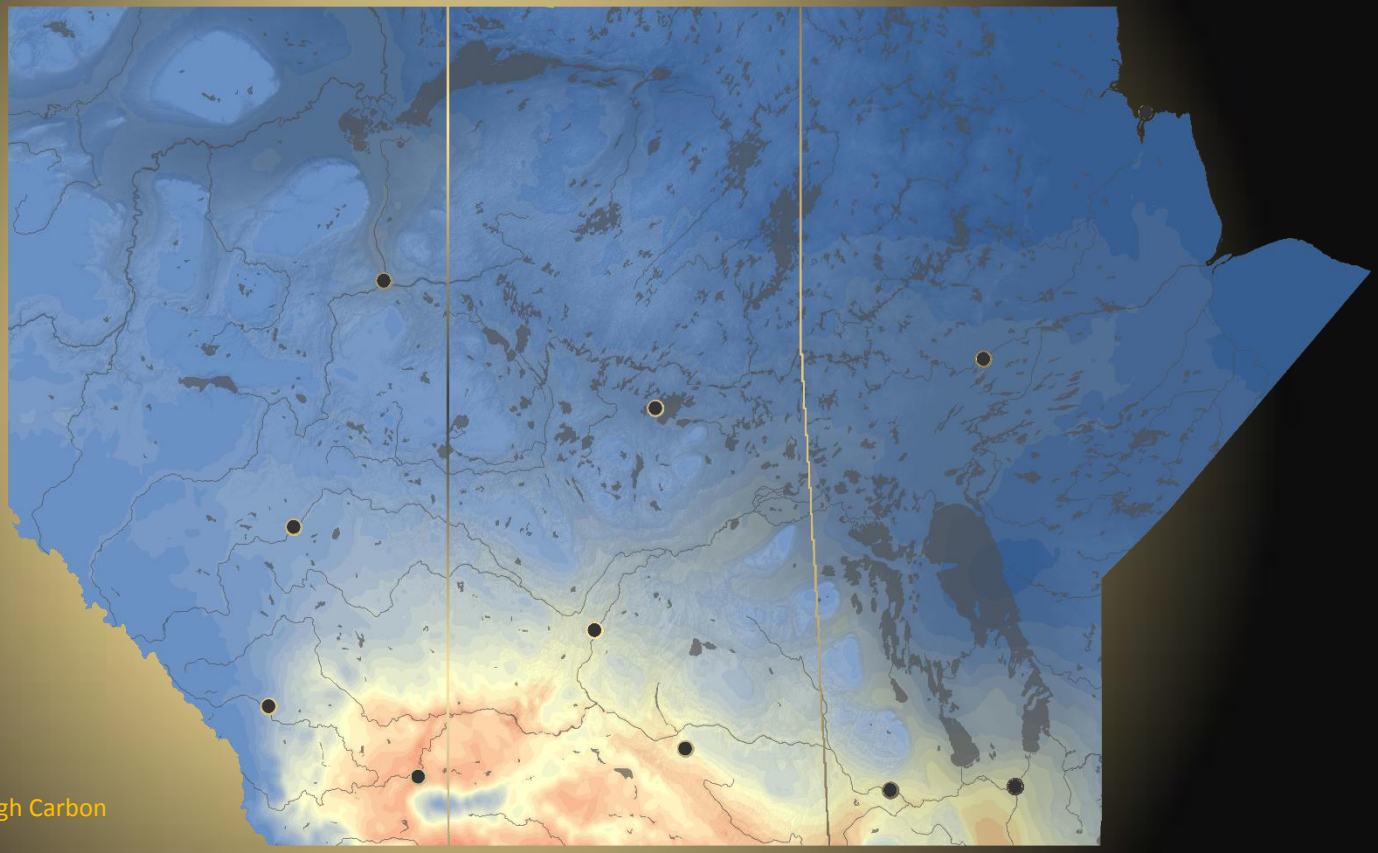



Data Source: Pacific Climate Impacts Consortium (PCIC), University of Victoria, (2014). Statistically Downscaled Climate Scenarios. Downloaded from pacificclimate.org.

# Shifting Extremes

*Change in the Number of Very Hot Days*

Prairie Climate Centre



**2021-2050** Annual number of days ≥ 30 °C

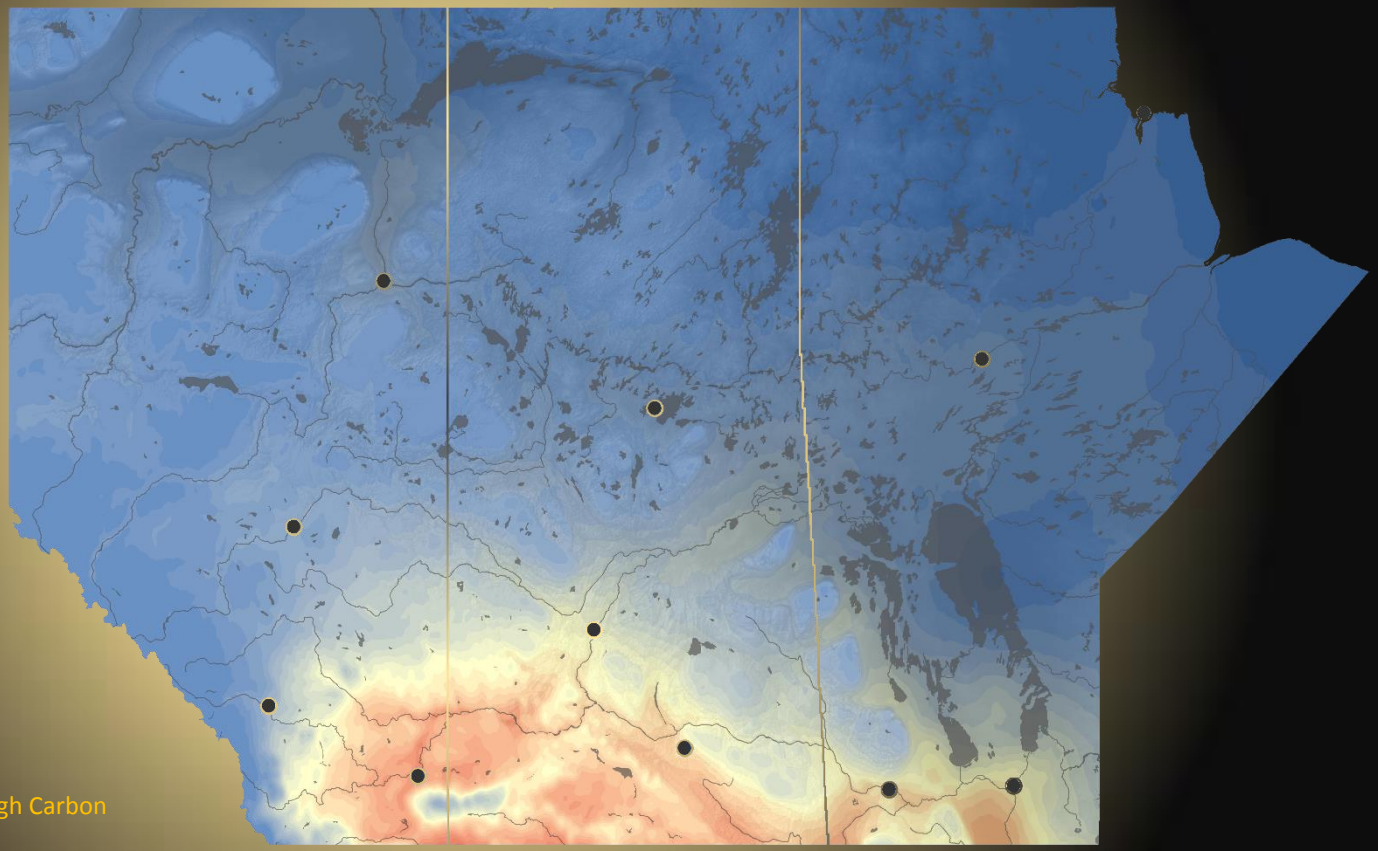
0 4 8 12 16 20 24 28 32 36 40 44 48+

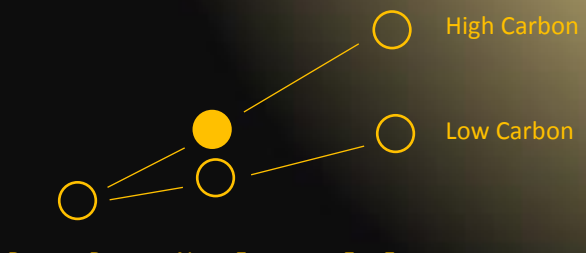

Data Source: Pacific Climate Impacts Consortium (PCIC), University of Victoria, (2014). Statistically Downscaled Climate Scenarios. Downloaded from pacificclimate.org.

# Shifting Extremes

*Change in the Number of Very Hot Days*

Prairie Climate Centre






**2021-2050** Annual number of days ≥ 30 °C

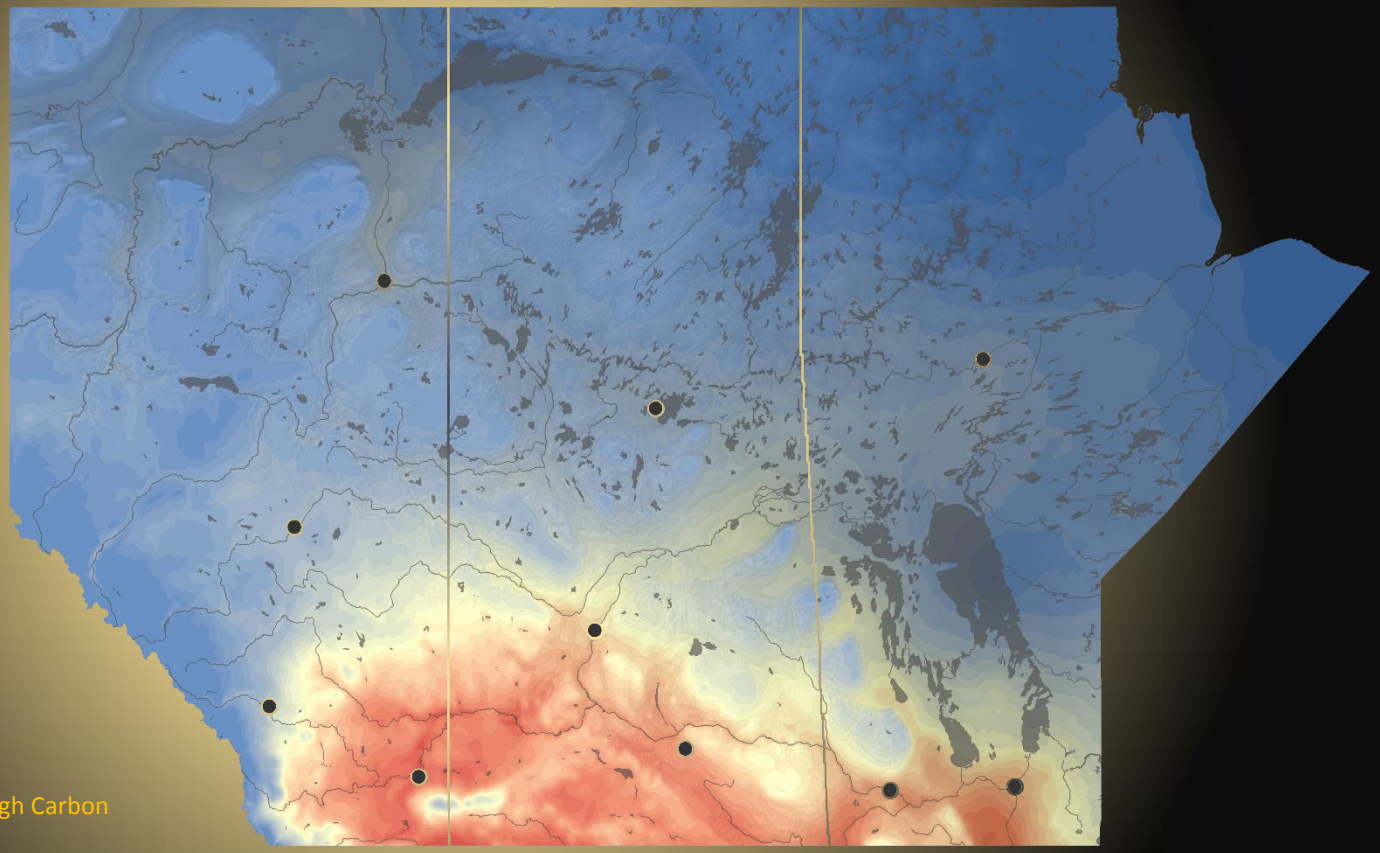
0 4 8 12 16 20 24 28 32 36 40 44 48+

Data Source: Pacific Climate Impacts Consortium (PCIC), University of Victoria, (2014). Statistically Downscaled Climate Scenarios. Downloaded from pacificclimate.org.

# Shifting Extremes

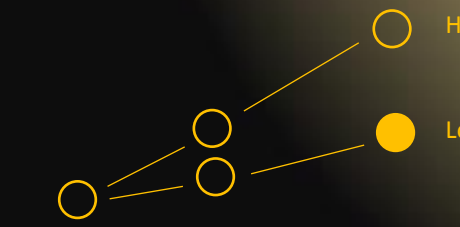
*Change in the Number of Very Hot Days*

Prairie Climate Centre



**2051-2080** Annual number of days ≥ 30 °C

0 4 8 12 16 20 24 28 32 36 40 44 48+

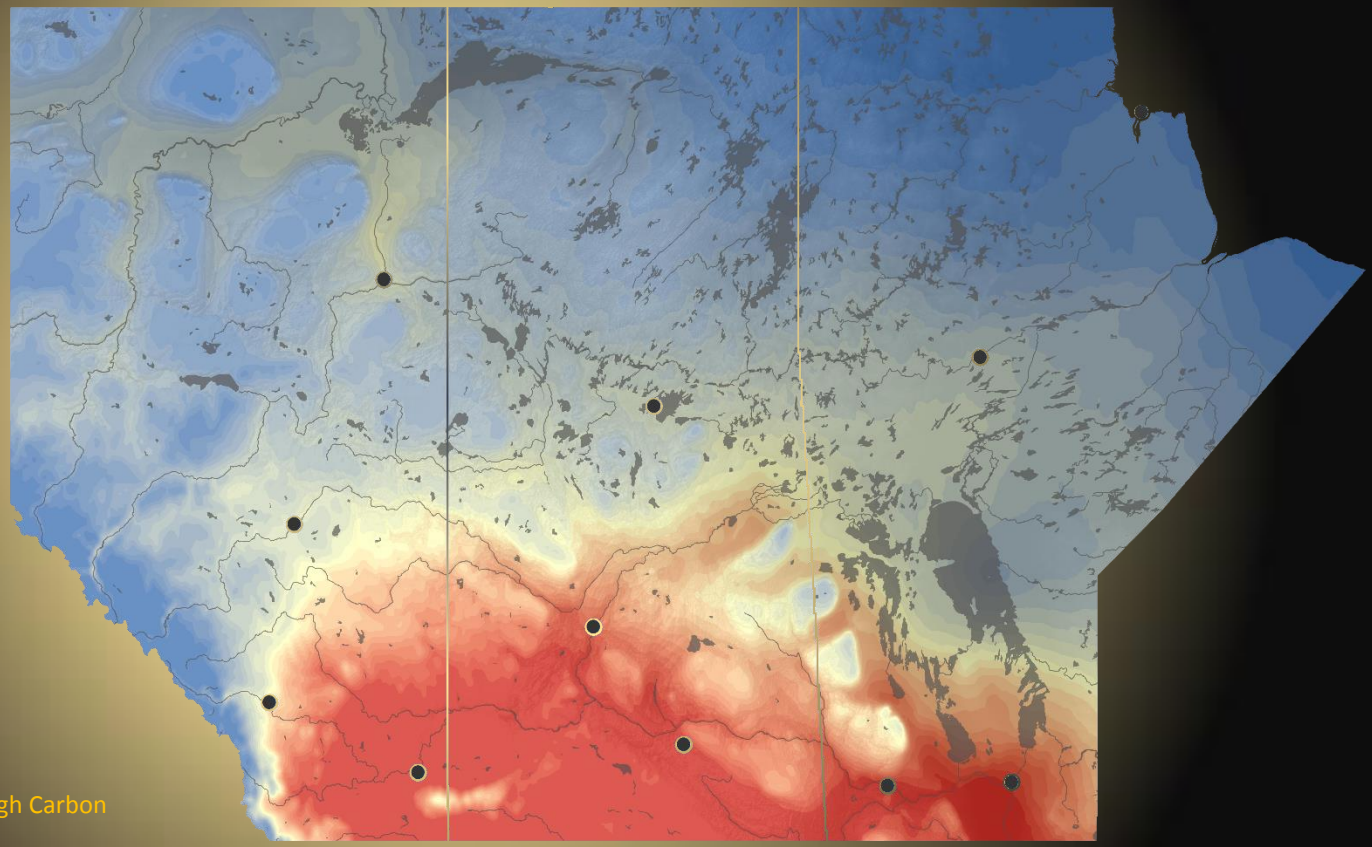



Data Source: Pacific Climate Impacts Consortium (PCIC), University of Victoria, (2014). Statistically Downscaled Climate Scenarios. Downloaded from pacificclimate.org.

# Shifting Extremes

*Change in the Number of Very Hot Days*

Prairie Climate Centre



High Carbon

Low Carbon

Recent Past  Near Future  Far Future

**2051-2080** Annual number of days ≥ 30 °C

0  4  8  12  16  20  24  28  32  36  40  44  48+

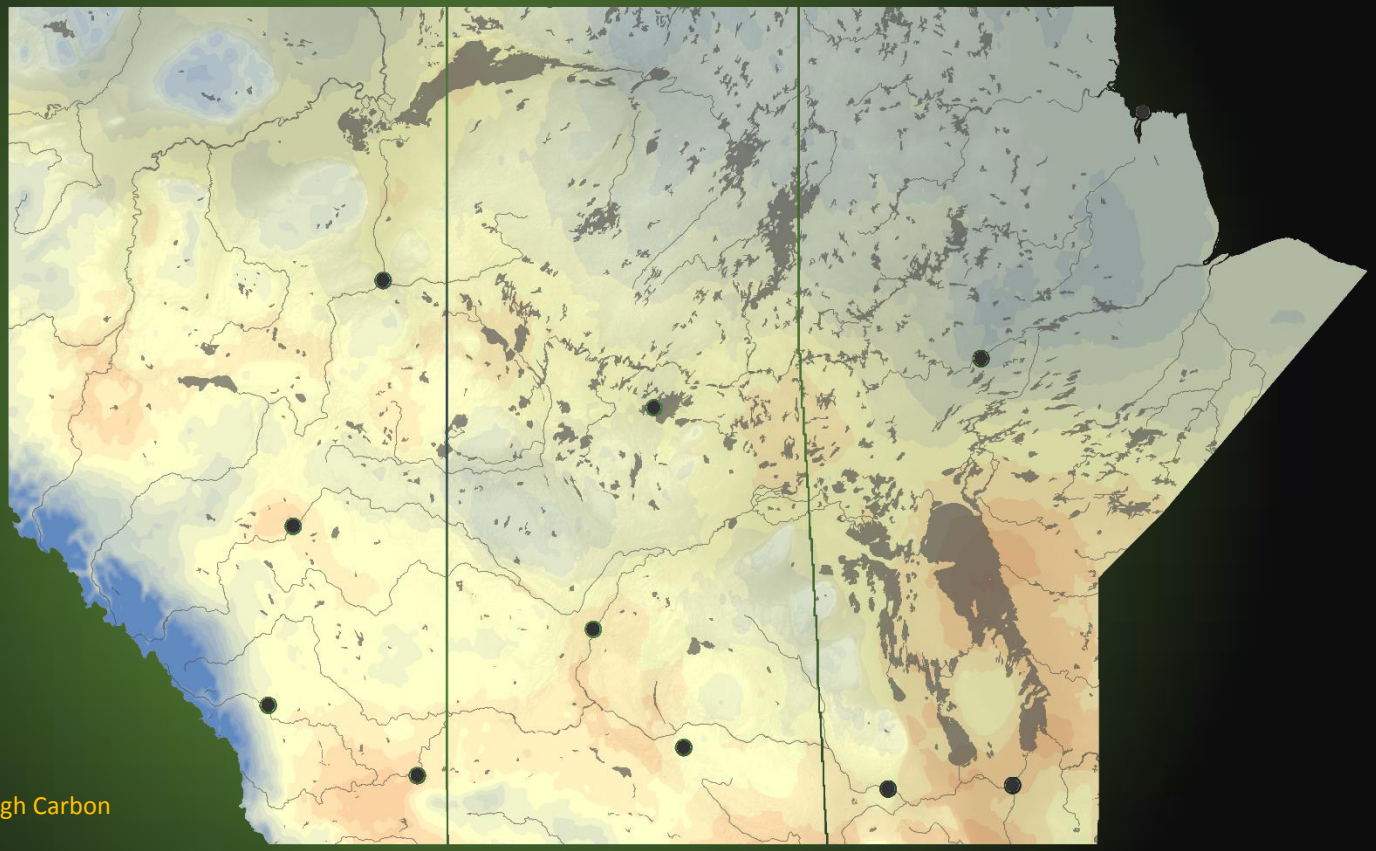
Data Source: Pacific Climate Impacts Consortium (PCIC), University of Victoria, (2014). Statistically Downscaled Climate Scenarios. Downloaded from pacificclimate.org.

# Frost-Free Period

# Frost-Free Period

*A Much Longer Growing Season*

Prairie Climate Centre




**1981-2010** Length of the Frost-Free Period (days)

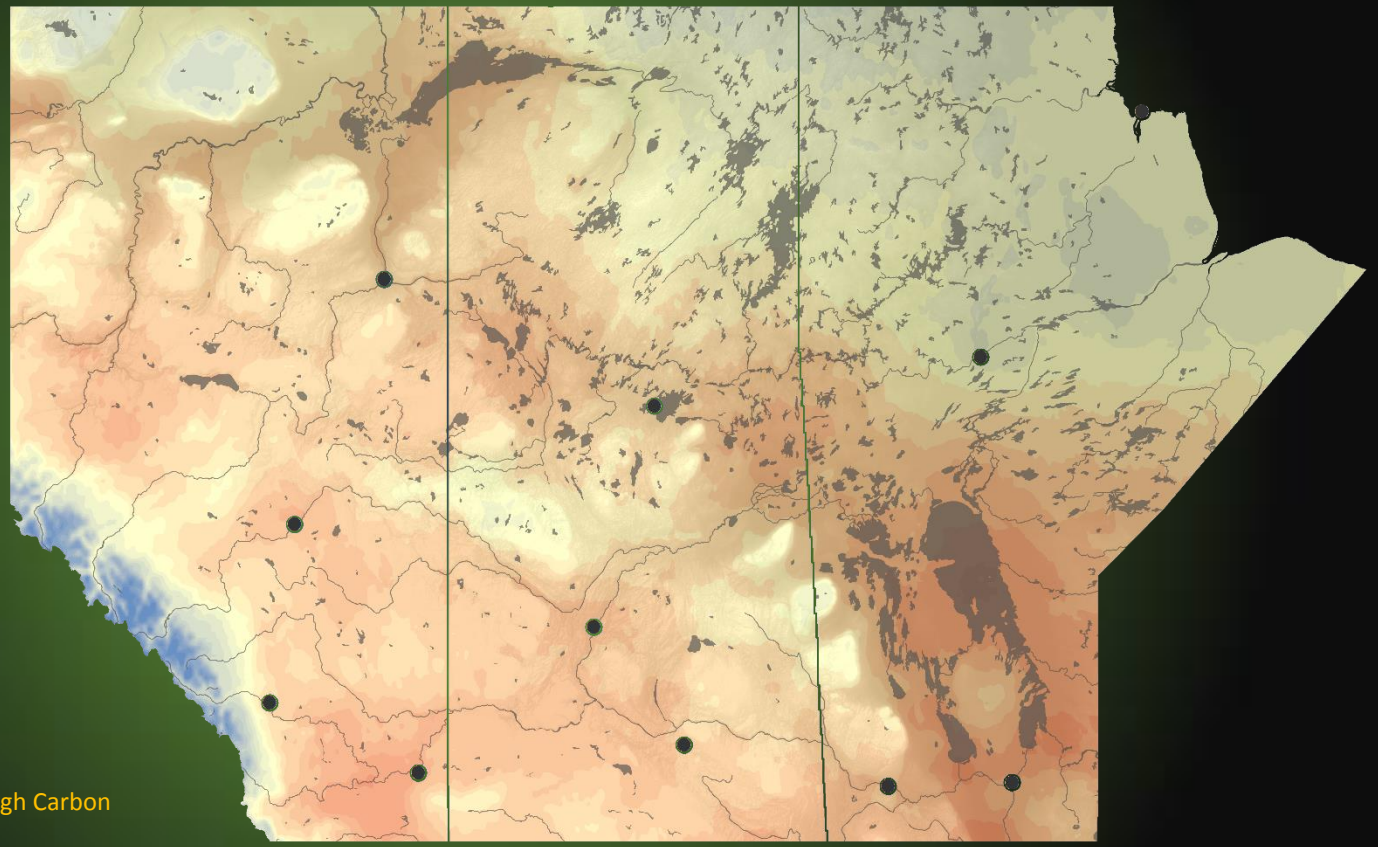
60 70 80 90 100 110 120 130 140 150 160 170 180+

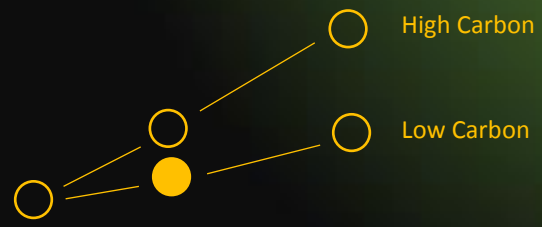
Data Source: Pacific Climate Impacts Consortium (PCIC), University of Victoria, (2014). Statistically Downscaled Climate Scenarios. Downloaded from pacificclimate.org.

# Frost-Free Period

*A Much Longer Growing Season*

Prairie Climate Centre






**2021-2050** Length of the Frost-Free Period (days)

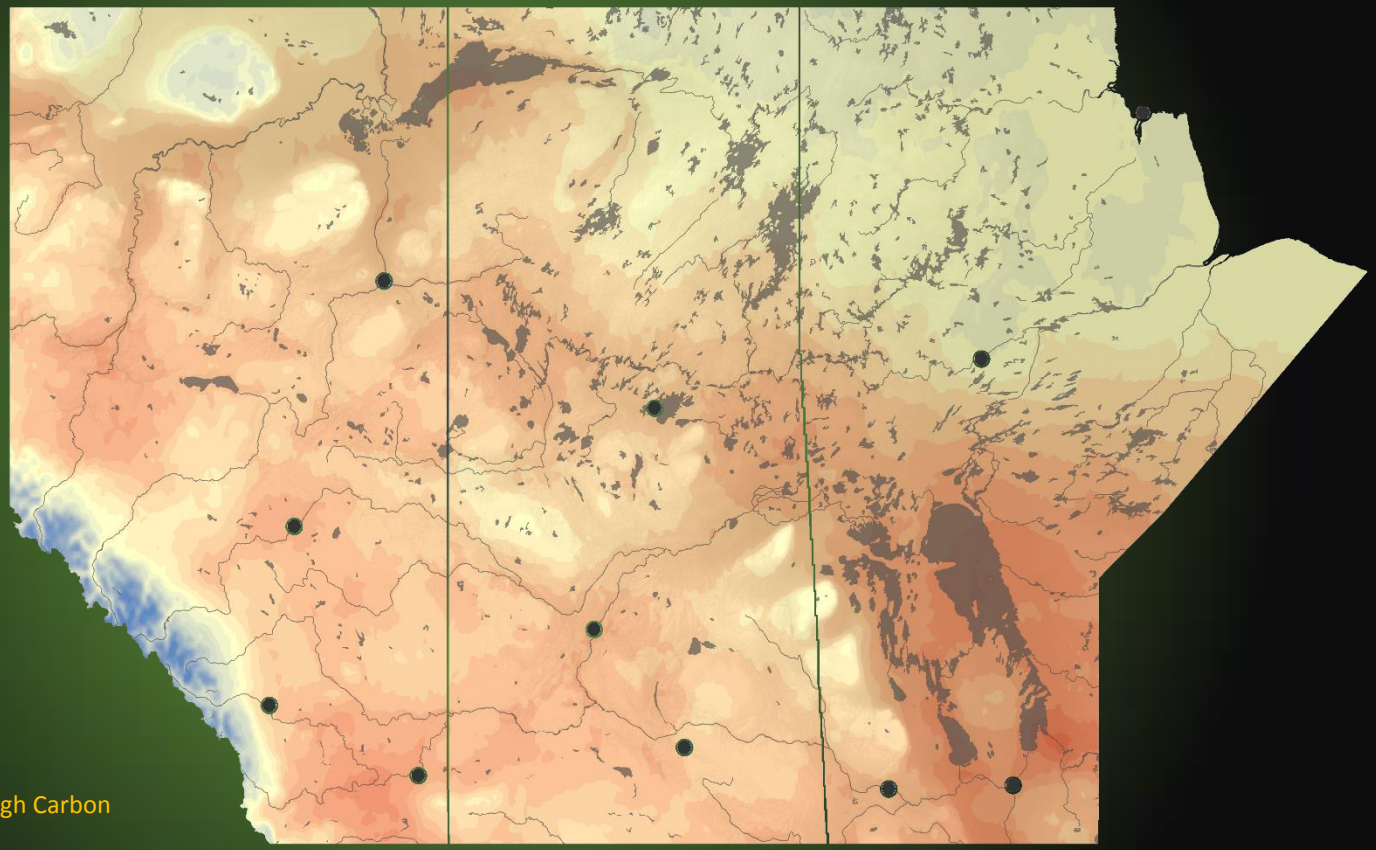
60 70 80 90 100 110 120 130 140 150 160 170 180+

Data Source: Pacific Climate Impacts Consortium (PCIC), University of Victoria, (2014). Statistically Downscaled Climate Scenarios. Downloaded from pacificclimate.org.

# Frost-Free Period

*A Much Longer Growing Season*

Prairie Climate Centre



**2021-2050** Length of the Frost-Free Period (days)

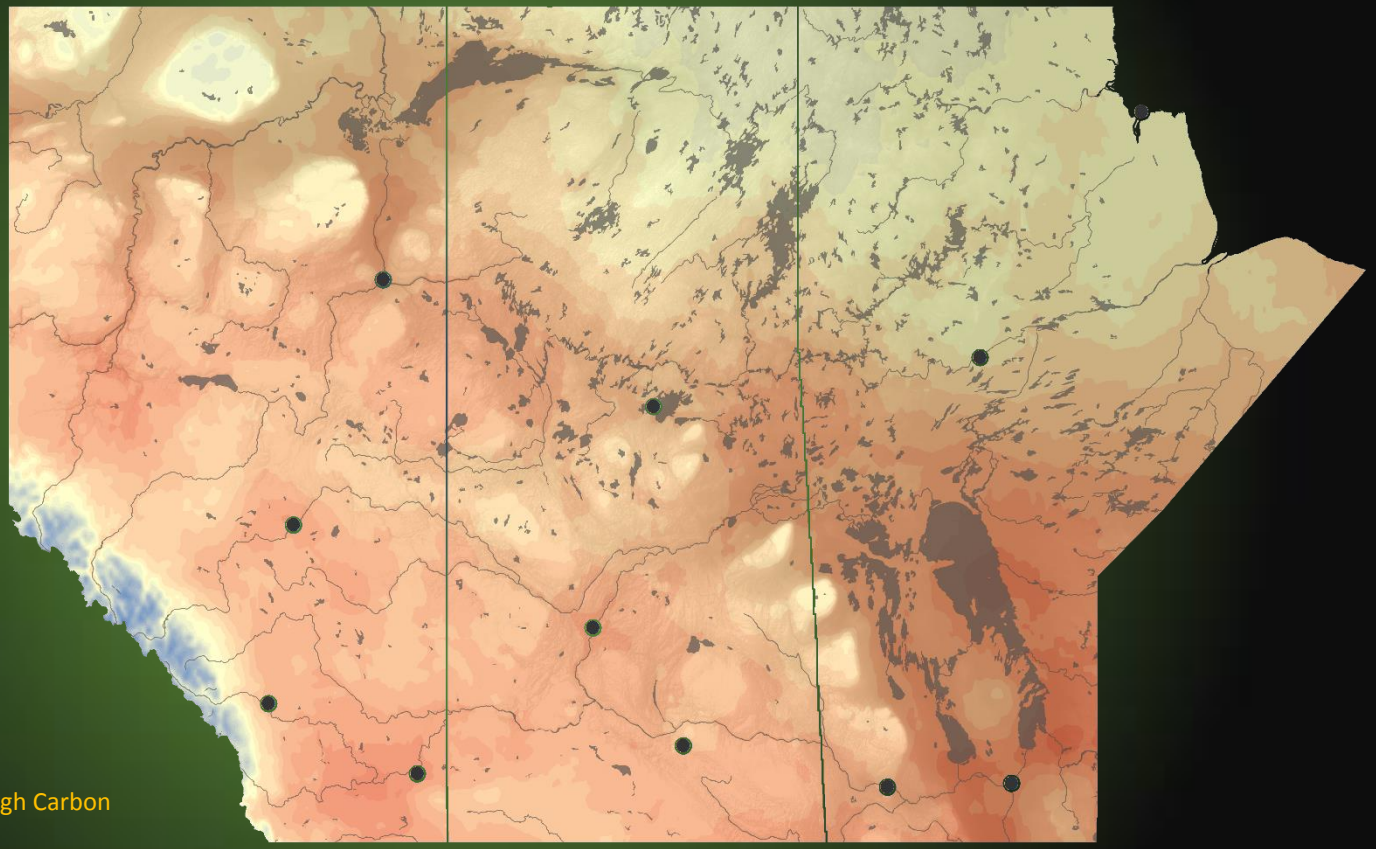
60 70 80 90 100 110 120 130 140 150 160 170 180+


Data Source: Pacific Climate Impacts Consortium (PCIC), University of Victoria, (2014). Statistically Downscaled Climate Scenarios. Downloaded from pacificclimate.org.

# Frost-Free Period

*A Much Longer Growing Season*

Prairie Climate Centre



High Carbon

Low Carbon

Recent Past  Near Future  Far Future

**2051-2080** Length of the Frost-Free Period (days)

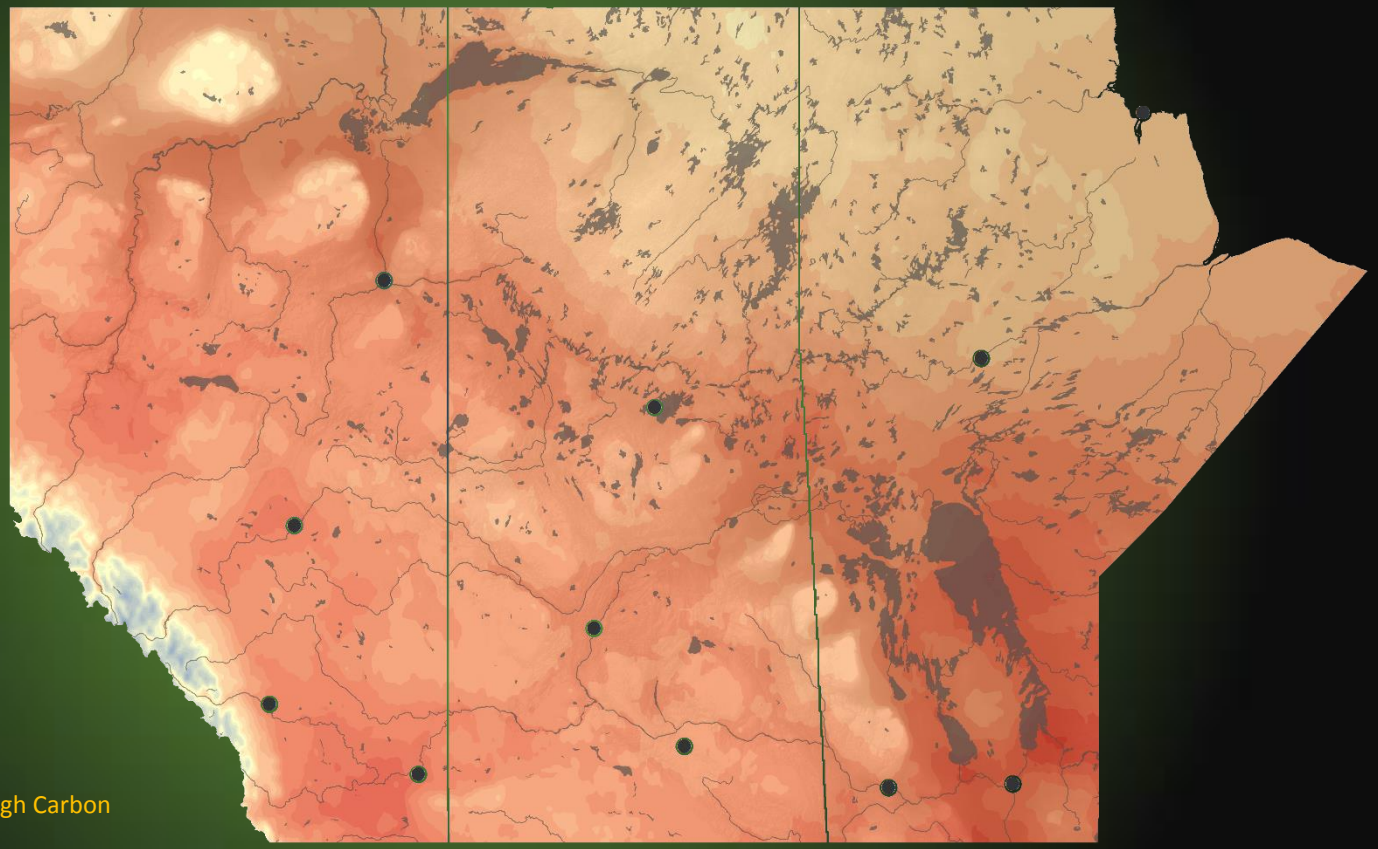
60  70  80  90  100  110  120  130  140  150  160  170  180+

Data Source: Pacific Climate Impacts Consortium (PCIC), University of Victoria, (2014). Statistically Downscaled Climate Scenarios. Downloaded from pacificclimate.org.

# Frost-Free Period

*A Much Longer Growing Season*

Prairie Climate Centre



High Carbon

Low Carbon

Recent Past  Near Future  Far Future

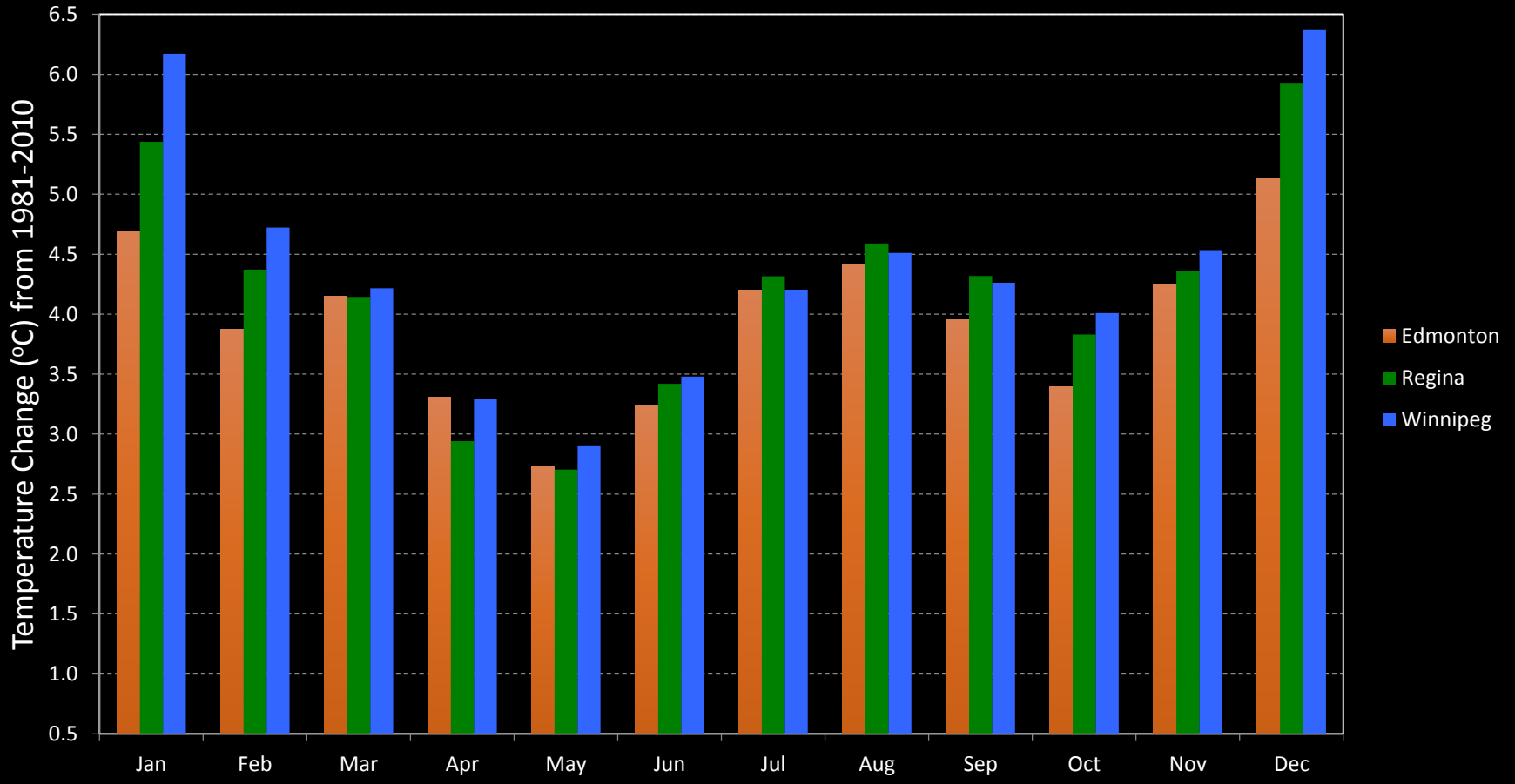
**2051-2080** Length of the Frost-Free Period (days)

60  70  80  90  100  110  120  130  140  150  160  170  180+

Data Source: Pacific Climate Impacts Consortium (PCIC), University of Victoria, (2014). Statistically Downscaled Climate Scenarios. Downloaded from pacificclimate.org.

# 2051-2080 ΔT: RCP8.5

Prairie Climate Centre

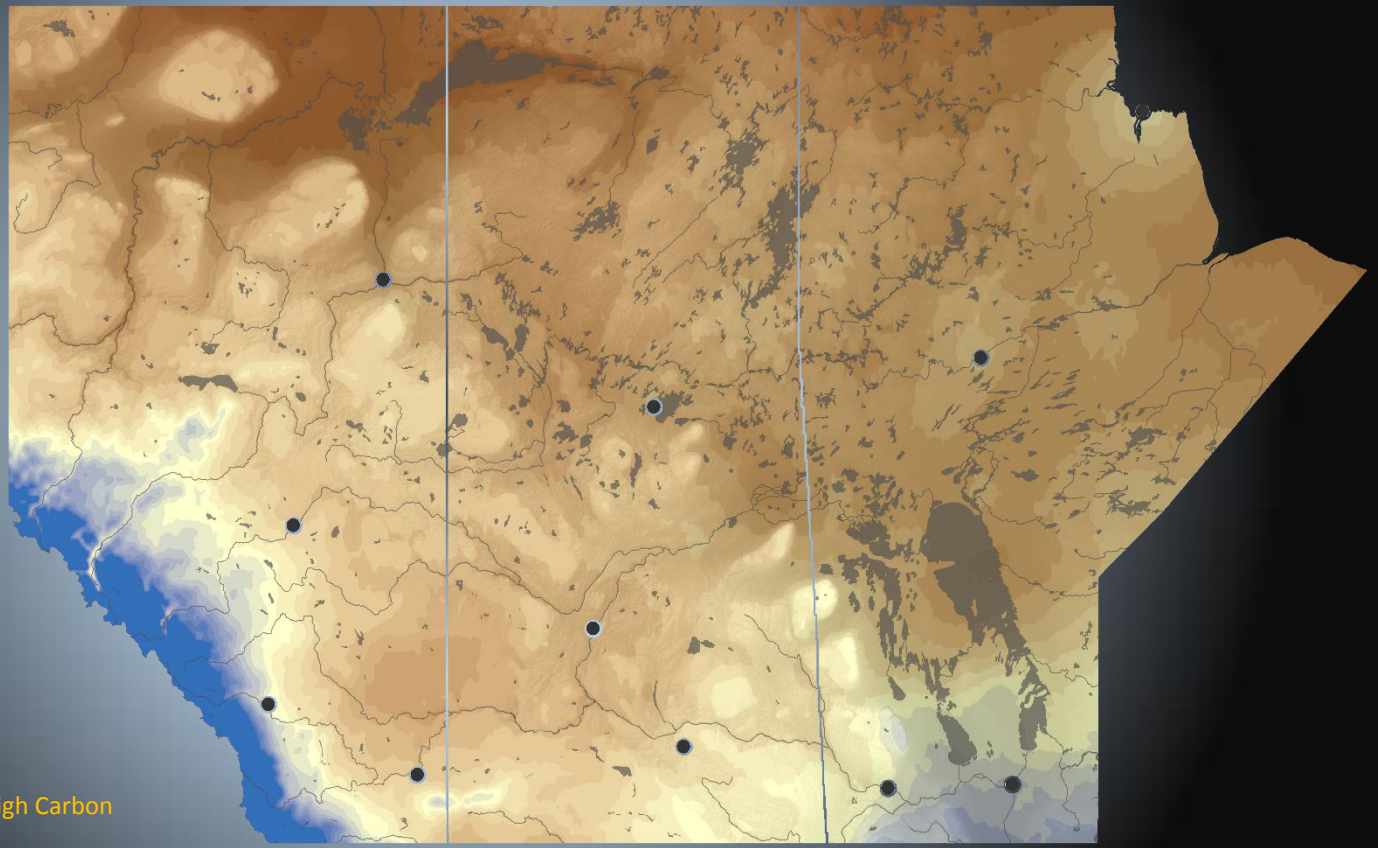


# Spring Precipitation

# Prairie Precipitation

*Projected Changes in Total Spring Precipitation*

Prairie Climate Centre



High Carbon

Low Carbon

Recent Past  Near Future  Far Future

**1981-2010** Total Spring Precipitation (mm)

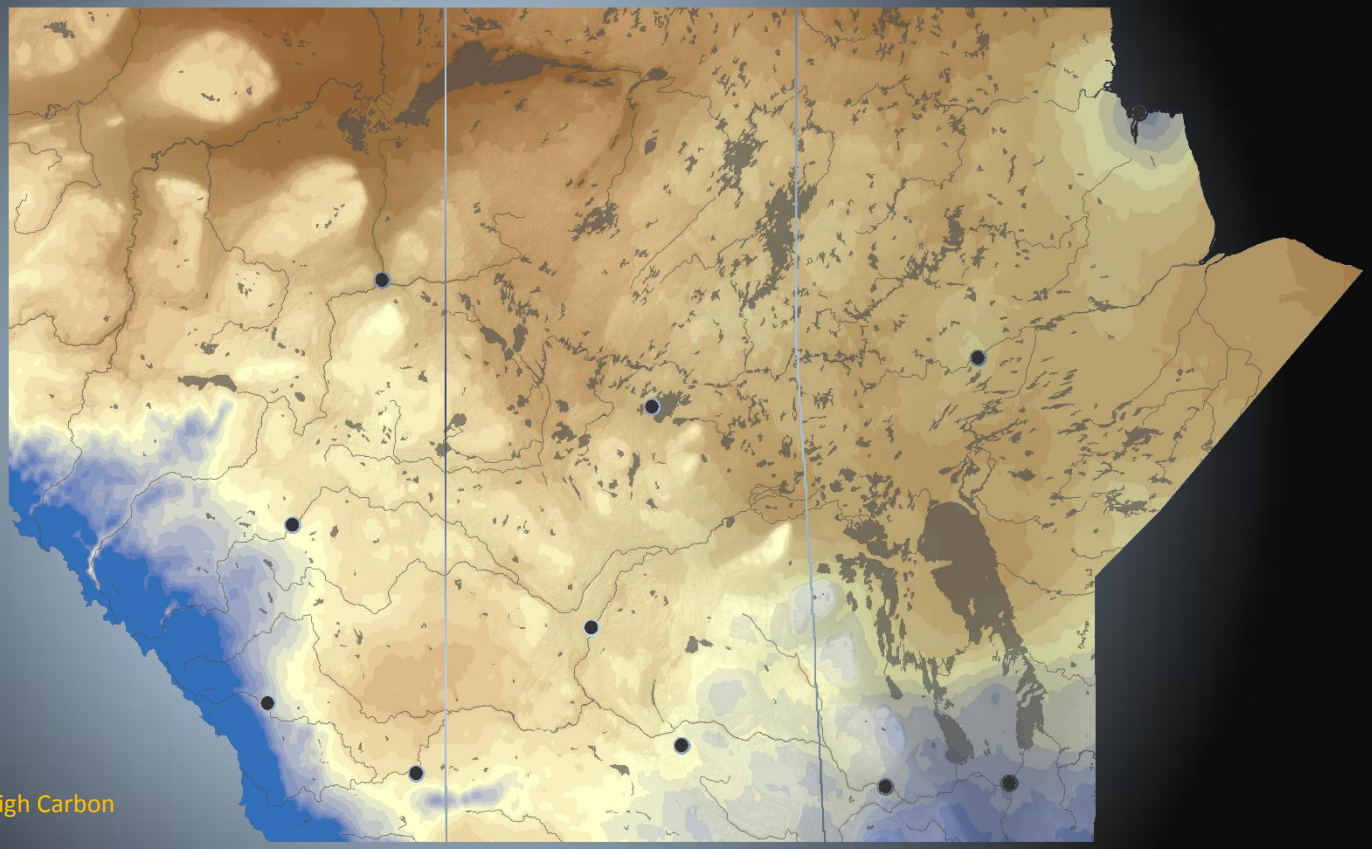
50  60  70  80  90  100  110  120  130  140  150+

Data Source: Pacific Climate Impacts Consortium (PCIC), University of Victoria, (2014). Statistically Downscaled Climate Scenarios. Downloaded from pacificclimate.org.

# Prairie Precipitation

*Projected Changes in Total Spring Precipitation*

Prairie Climate Centre



High Carbon

Low Carbon

Recent Past  Near Future  Far Future

**2021-2050** Total Spring Precipitation (mm)

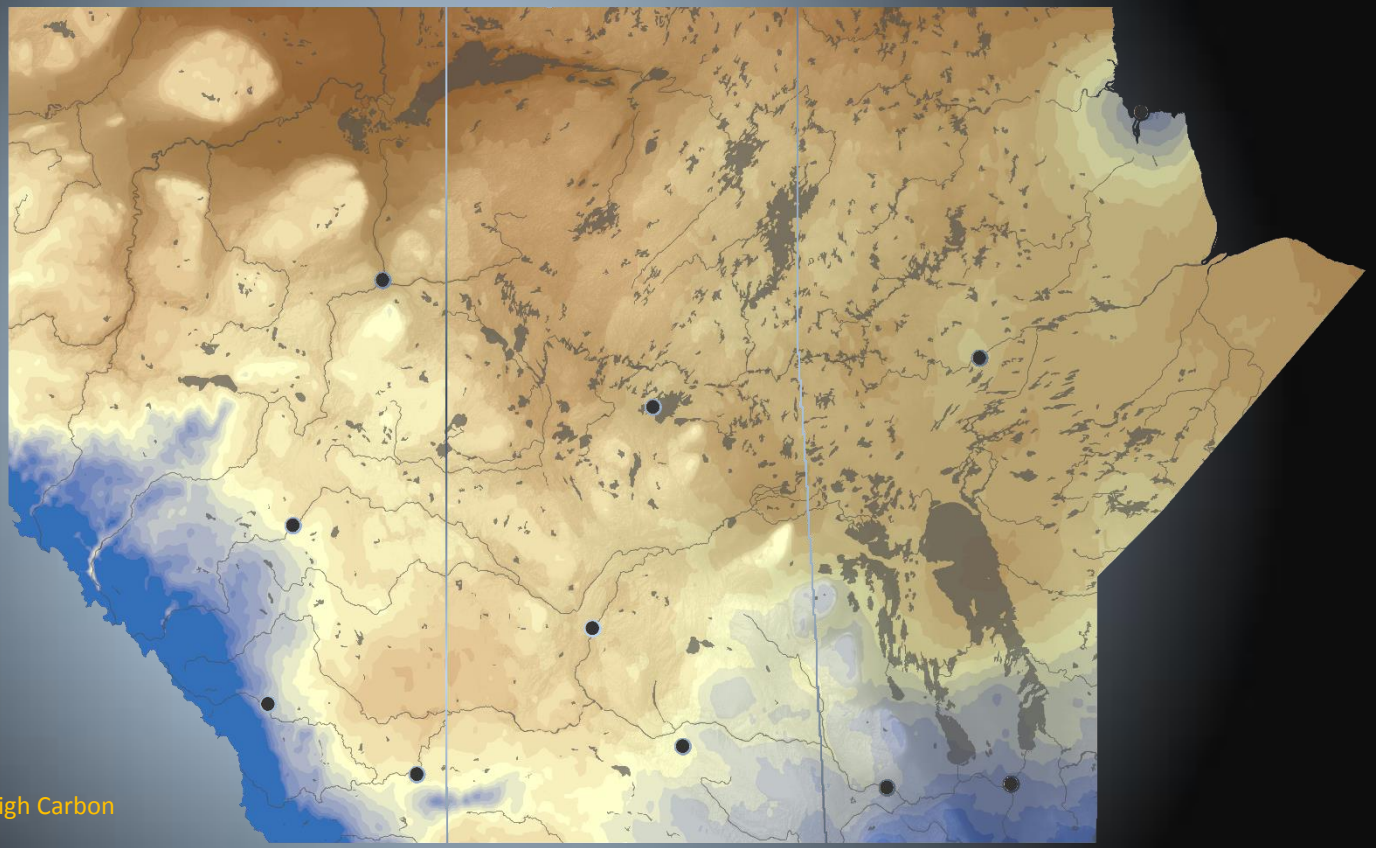
50  60  70  80  90  100  110  120  130  140  150+

Data Source: Pacific Climate Impacts Consortium (PCIC), University of Victoria, (2014). Statistically Downscaled Climate Scenarios. Downloaded from pacificclimate.org.

# Prairie Precipitation

*Projected Changes in Total Spring Precipitation*

Prairie Climate Centre



High Carbon

Low Carbon

Recent Past  Near Future  Far Future

**2021-2050** Total Spring Precipitation (mm)

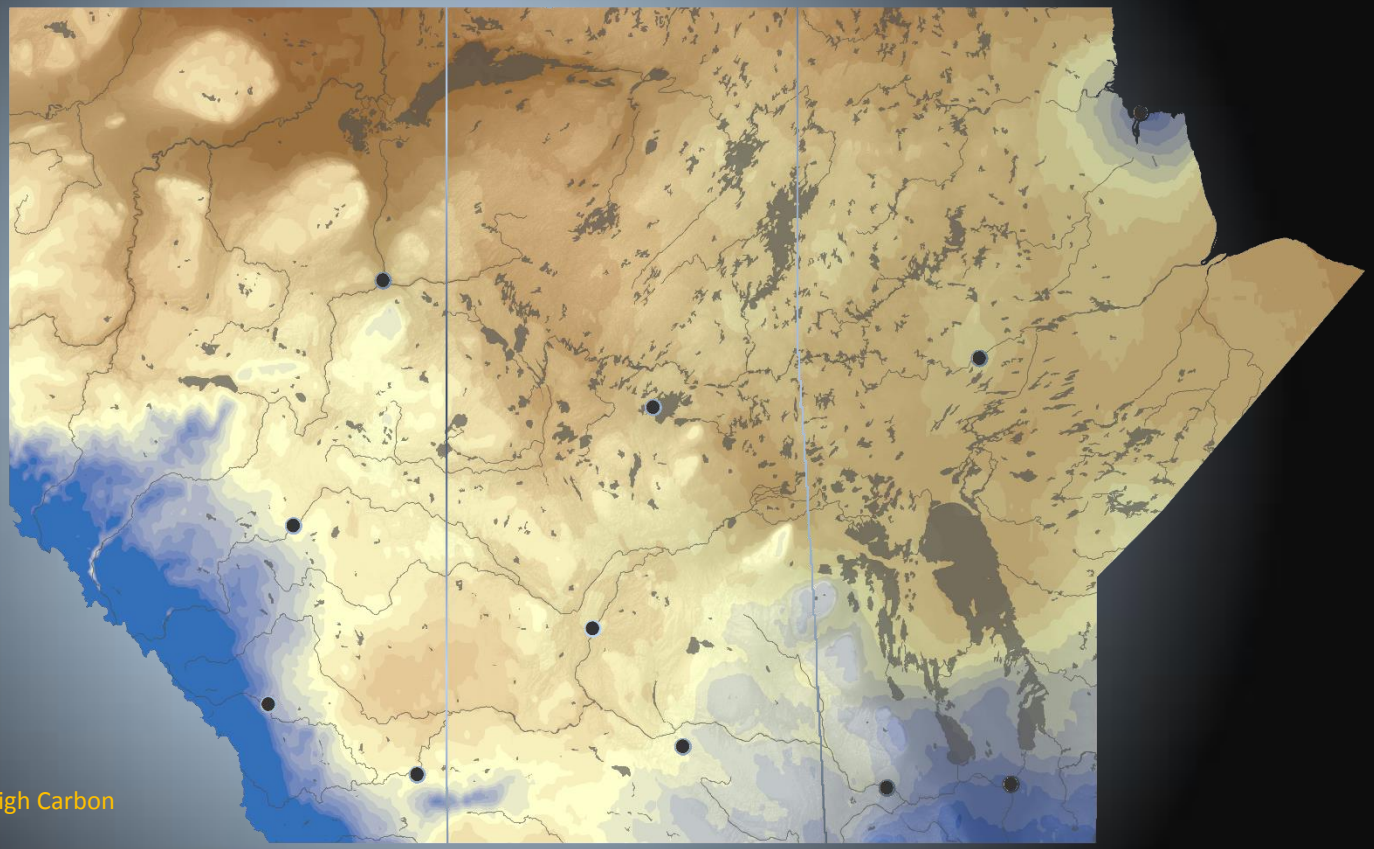
50  60  70  80  90  100  110  120  130  140  150+

Data Source: Pacific Climate Impacts Consortium (PCIC), University of Victoria, (2014). Statistically Downscaled Climate Scenarios. Downloaded from pacificclimate.org.

# Prairie Precipitation

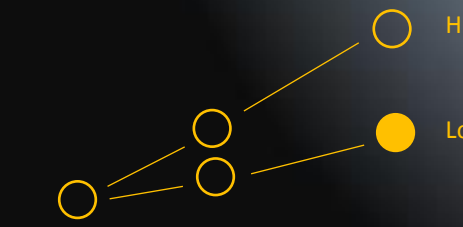
*Projected Changes in Total Spring Precipitation*

Prairie Climate Centre



**2051-2080** Total Spring Precipitation (mm)

50 60 70 80 90 100 110 120 130 140 150+

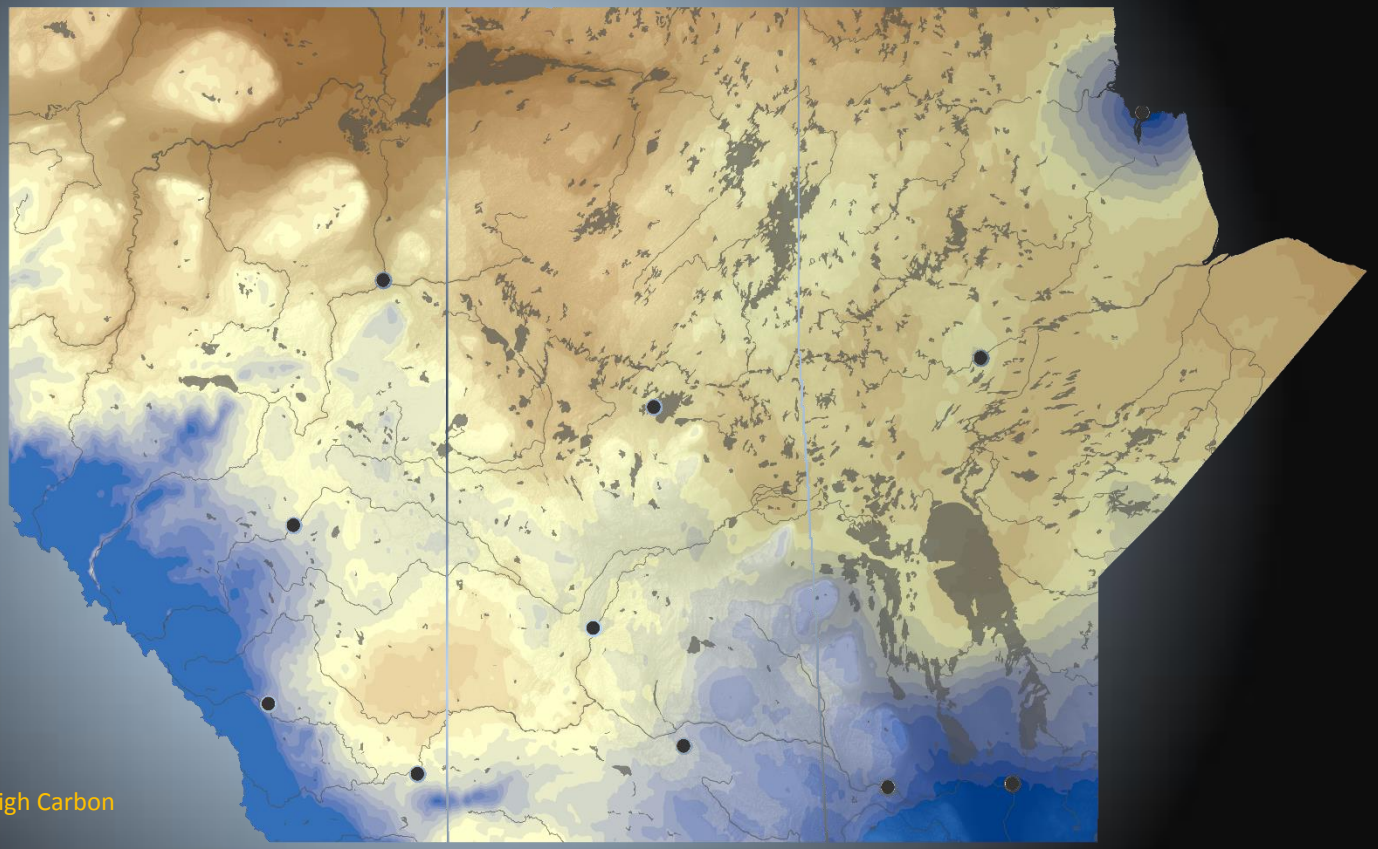



Data Source: Pacific Climate Impacts Consortium (PCIC), University of Victoria, (2014). Statistically Downscaled Climate Scenarios. Downloaded from pacificclimate.org.

# Prairie Precipitation

*Projected Changes in Total Spring Precipitation*

Prairie Climate Centre



High Carbon

Low Carbon

Recent Past  Near Future  Far Future

**2051-2080** Total Spring Precipitation (mm)

50  60  70  80  90  100  110  120  130  140  150+

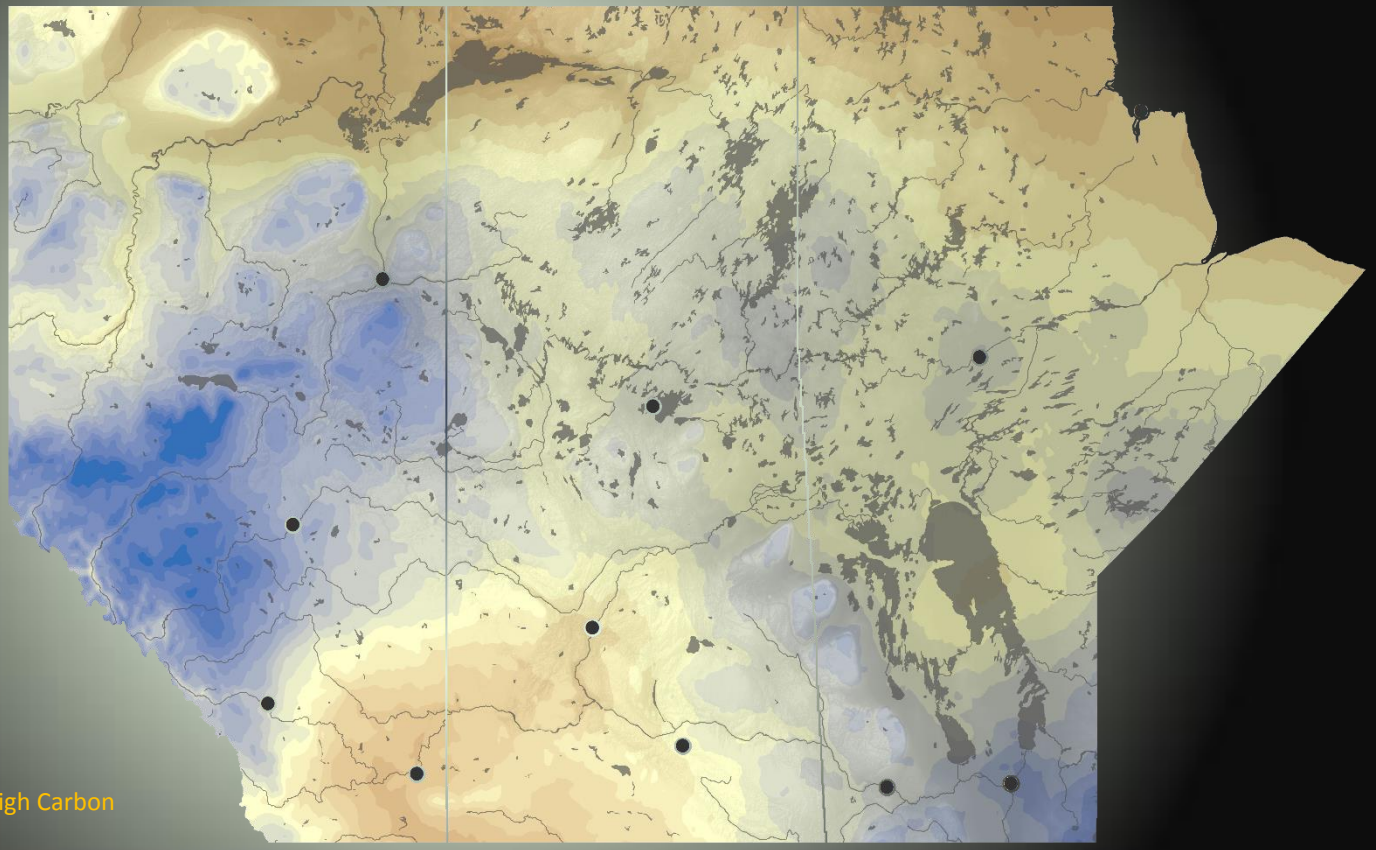
Data Source: Pacific Climate Impacts Consortium (PCIC), University of Victoria, (2014). Statistically Downscaled Climate Scenarios. Downloaded from pacificclimate.org.

# Summer Precipitation

# Prairie Precipitation

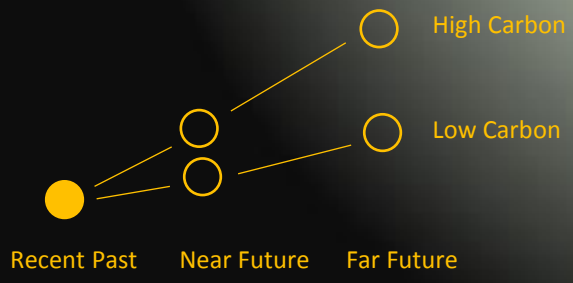
*Projected Changes in Total Summer Precipitation*

Prairie Climate Centre



**1981-2010** Total Summer Precipitation (mm)

70 90 110 130 150 170 190 210 230 250 270 290+

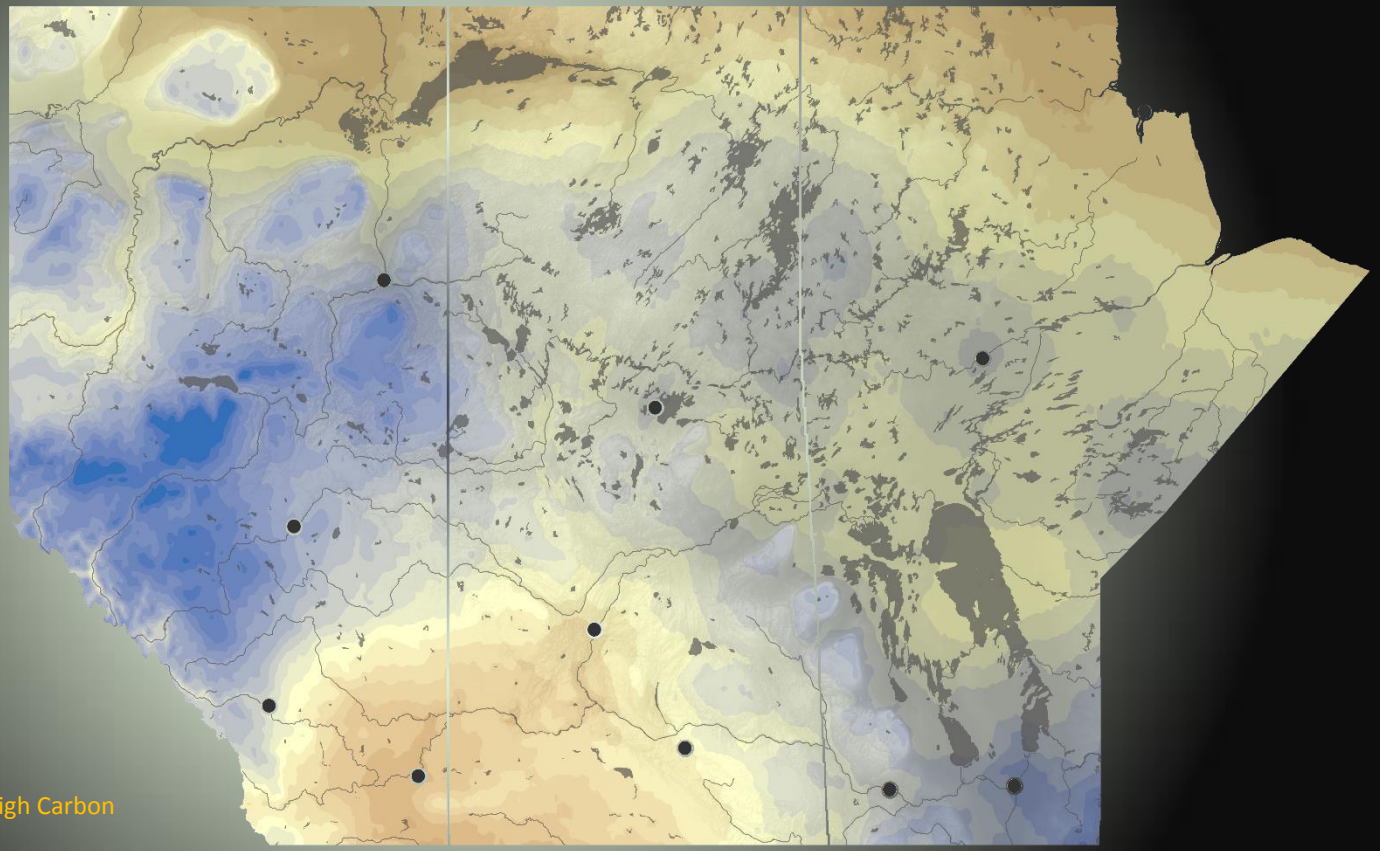



Data Source: Pacific Climate Impacts Consortium (PCIC), University of Victoria, (2014). Statistically Downscaled Climate Scenarios. Downloaded from pacificclimate.org.

# Prairie Precipitation

*Projected Changes in Total Summer Precipitation*

Prairie Climate Centre



High Carbon

Low Carbon

Recent Past  Near Future  Far Future

**2021-2050** Total Summer Precipitation (mm)

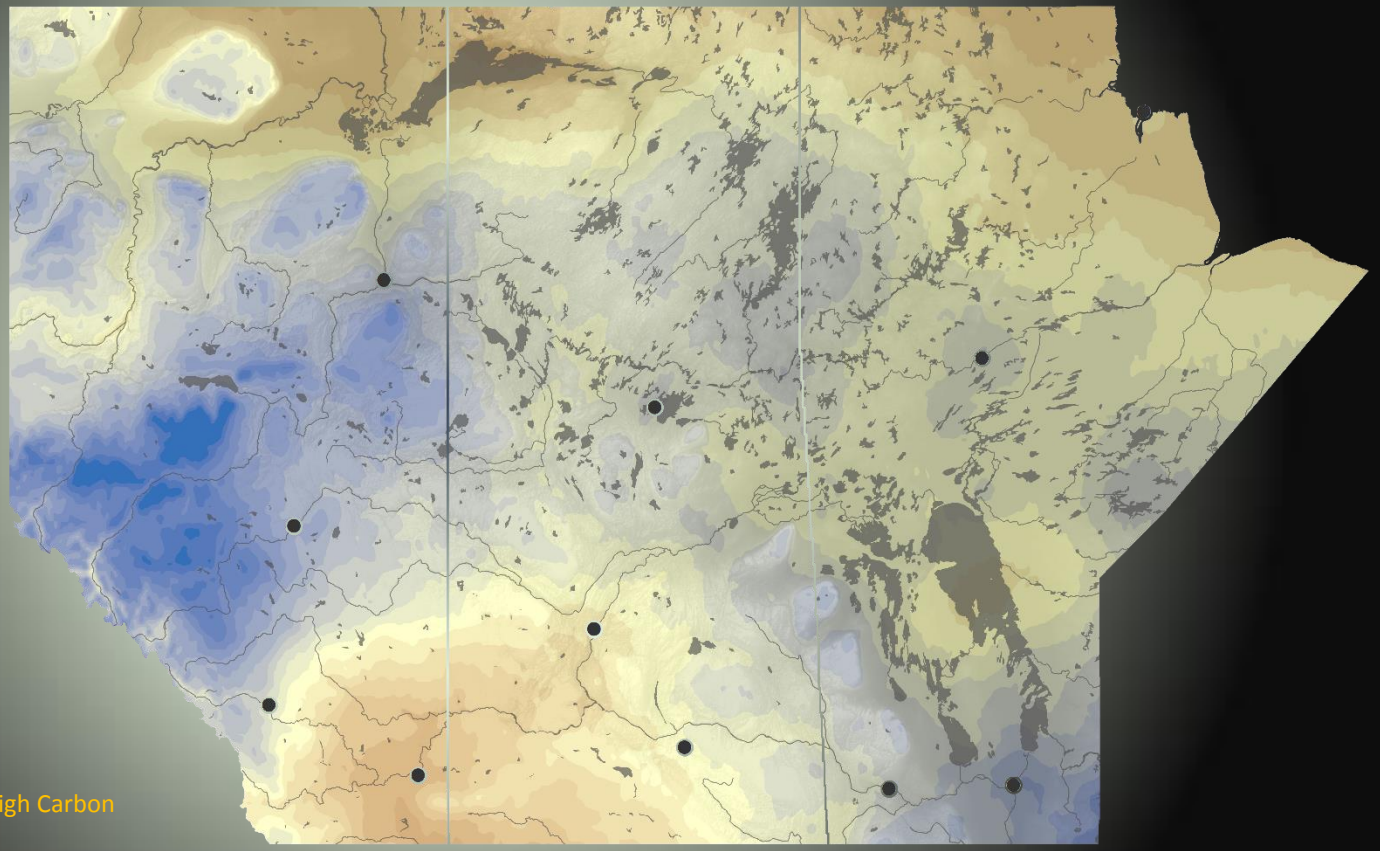
70  90  110  130  150  170  190  210  230  250  270  290+

Data Source: Pacific Climate Impacts Consortium (PCIC), University of Victoria, (2014). Statistically Downscaled Climate Scenarios. Downloaded from pacificclimate.org.

# Prairie Precipitation

*Projected Changes in Total Summer Precipitation*

Prairie Climate Centre



High Carbon

Low Carbon

Recent Past  Near Future  Far Future

**2021-2050** Total Summer Precipitation (mm)

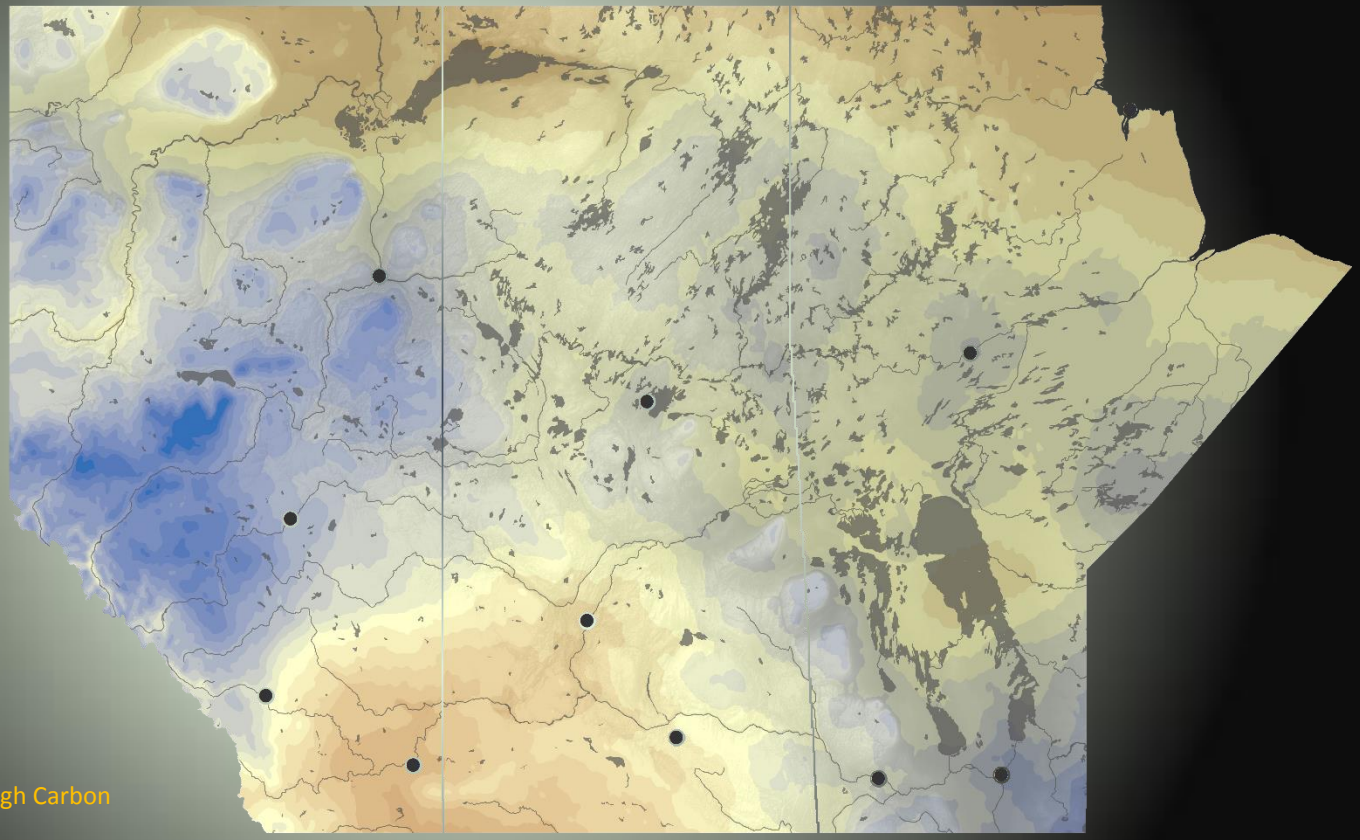
70  90  110  130  150  170  190  210  230  250  270  290+

Data Source: Pacific Climate Impacts Consortium (PCIC), University of Victoria, (2014). Statistically Downscaled Climate Scenarios. Downloaded from pacificclimate.org.

# Prairie Precipitation

*Projected Changes in Total Summer Precipitation*

Prairie Climate Centre



High Carbon

Low Carbon

Recent Past  Near Future  Far Future

**2051-2080** Total Summer Precipitation (mm)

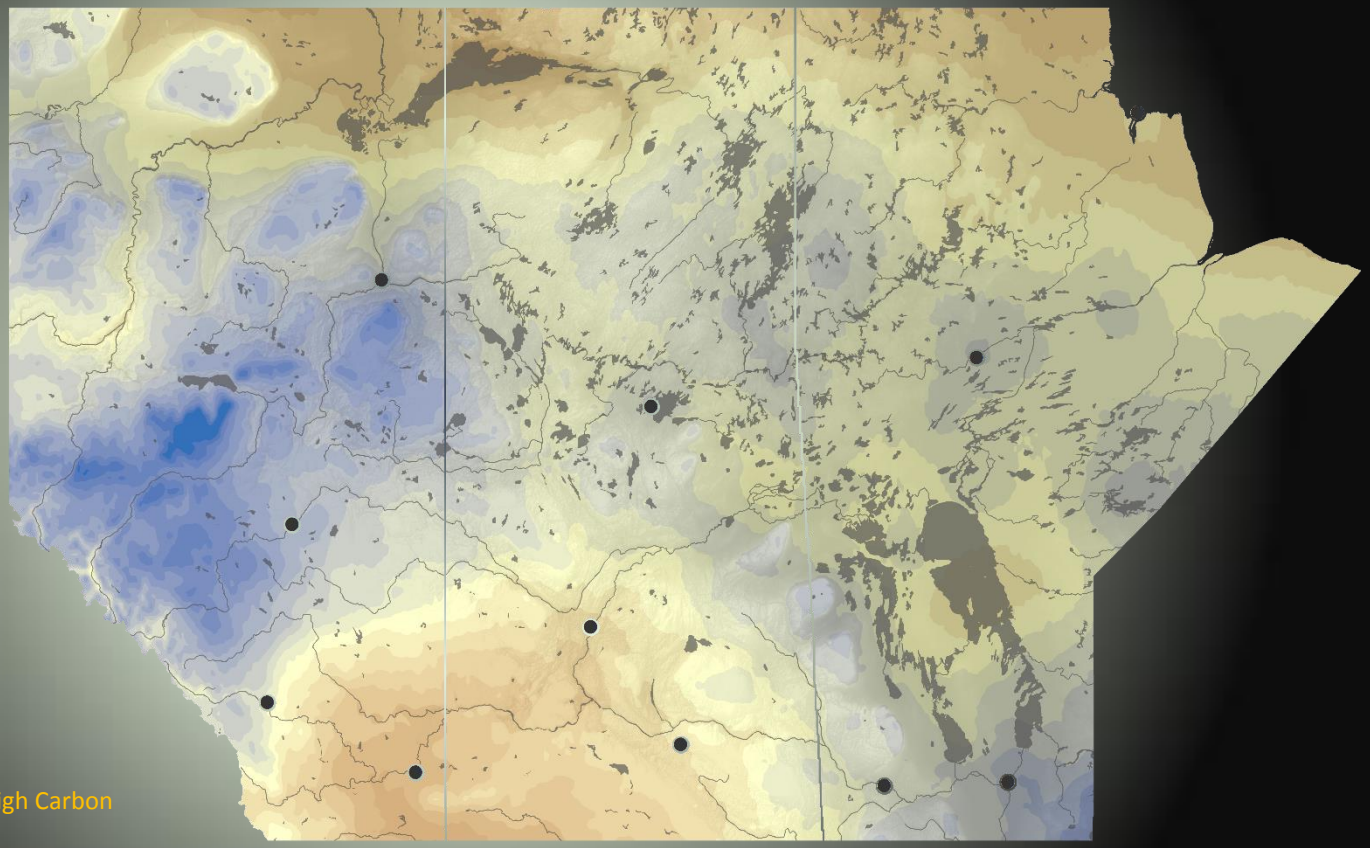
70  90  110  130  150  170  190  210  230  250  270  290+

Data Source: Pacific Climate Impacts Consortium (PCIC), University of Victoria, (2014). Statistically Downscaled Climate Scenarios. Downloaded from pacificclimate.org.

# Prairie Precipitation

*Projected Changes in Total Summer Precipitation*

Prairie Climate Centre



High Carbon

Low Carbon

Recent Past  Near Future  Far Future

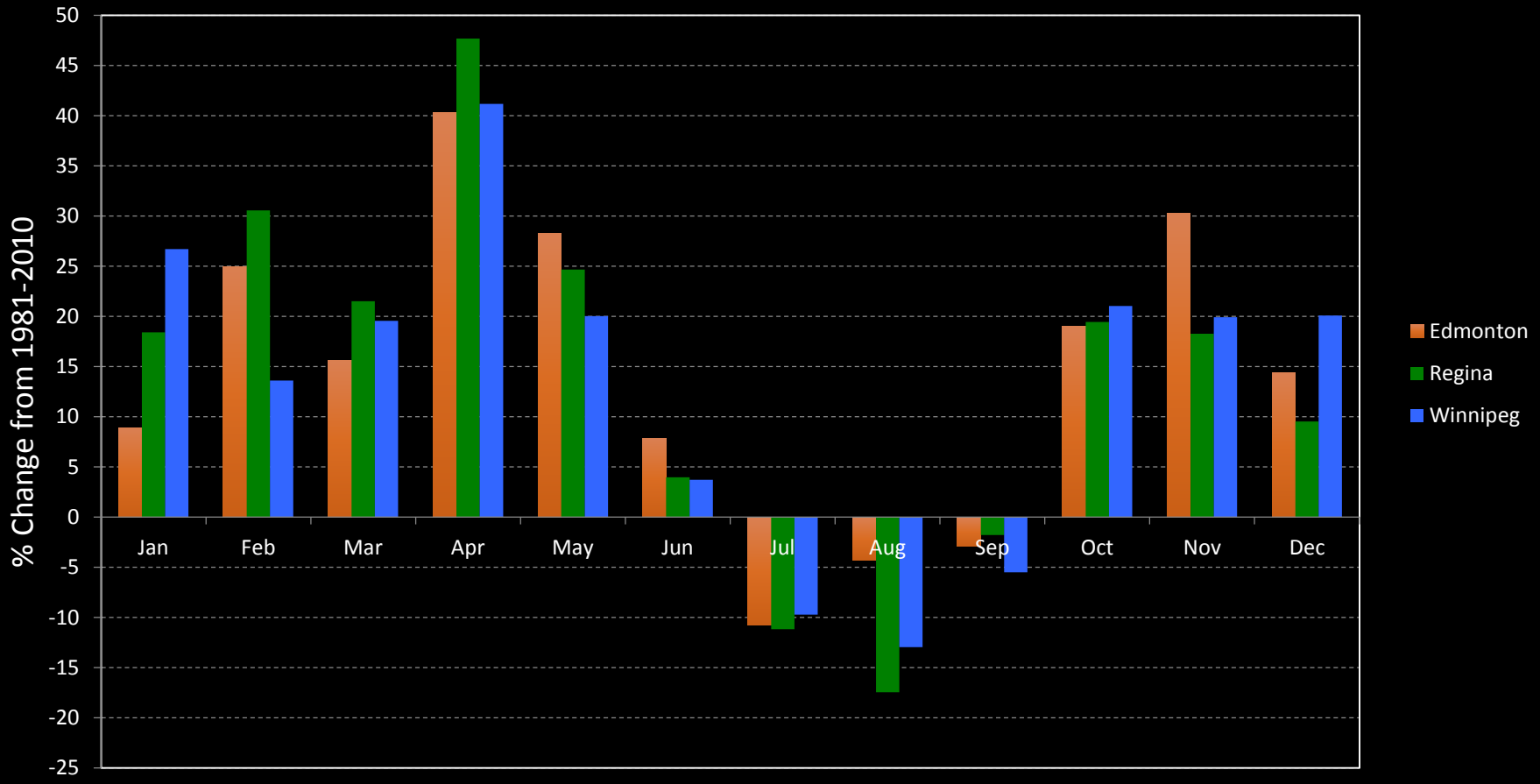
**2051-2080** Total Summer Precipitation (mm)

70  90  110  130  150  170  190  210  230  250  270  290+

Data Source: Pacific Climate Impacts Consortium (PCIC), University of Victoria, (2014). Statistically Downscaled Climate Scenarios. Downloaded from pacificclimate.org.

# 2051-2080 ΔPPT: RCP8.5

Prairie Climate Centre



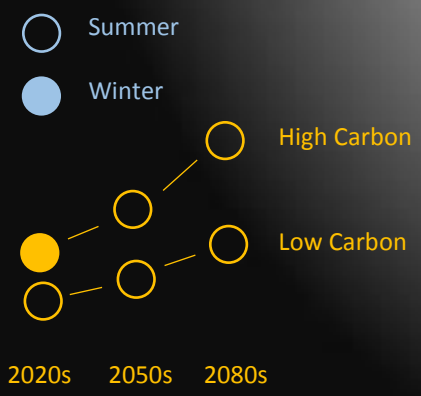
# An Example of Climate Analogues

# Winnipeg

*Winter Climate Analogues*

Prairie Climate Centre

AdaptWest data was used to identify whose climates we will have in the future, using seasonal temperature and precipitation projections.

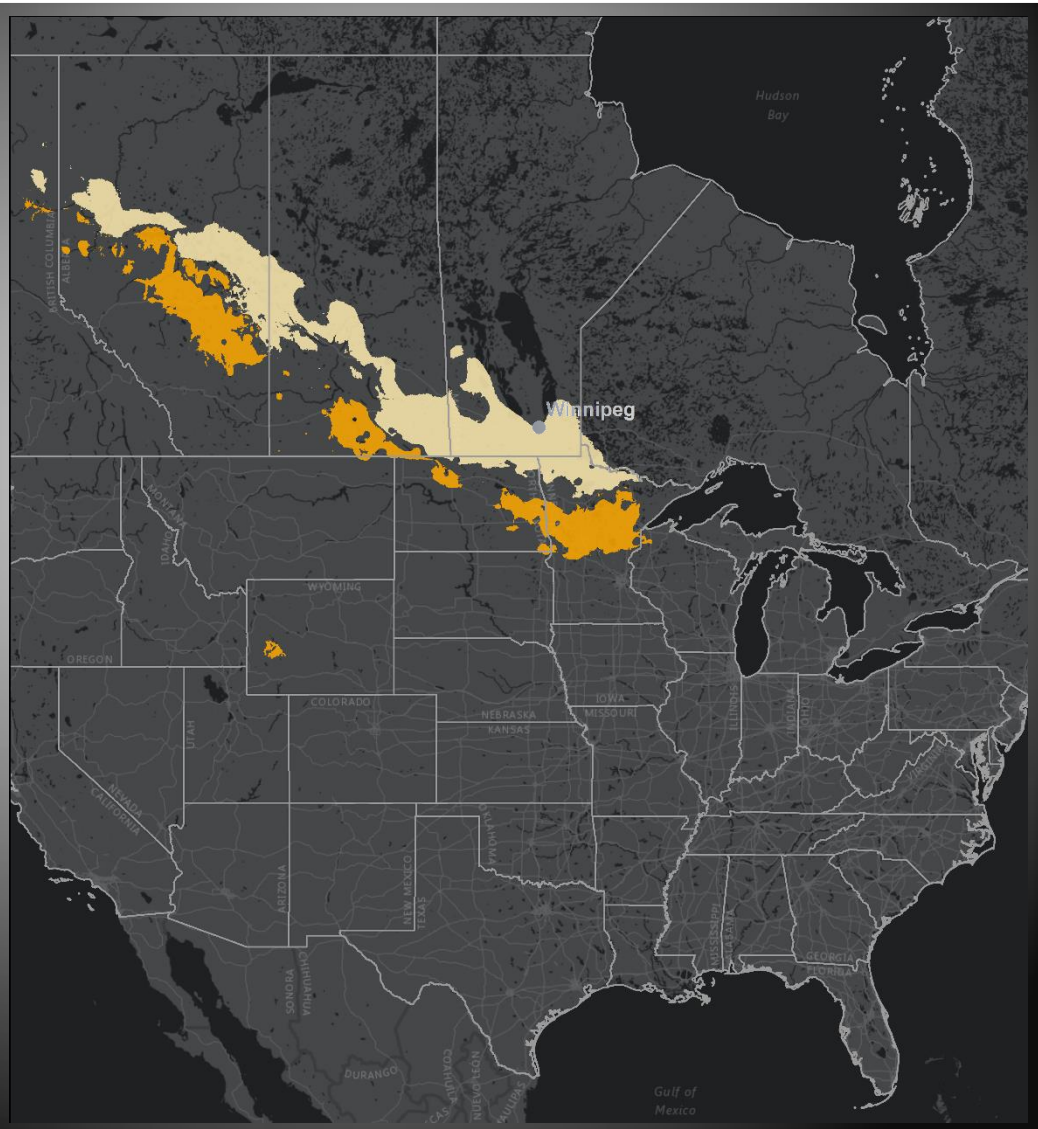
# Winnipeg

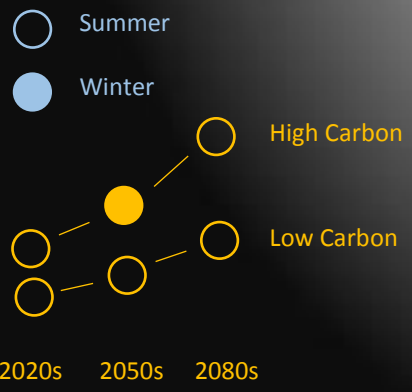
*Winter Climate Analogues*

Prairie Climate Centre

Similarity index:

- Mean temperature within 1 ° C
- Total precipitation within 20%

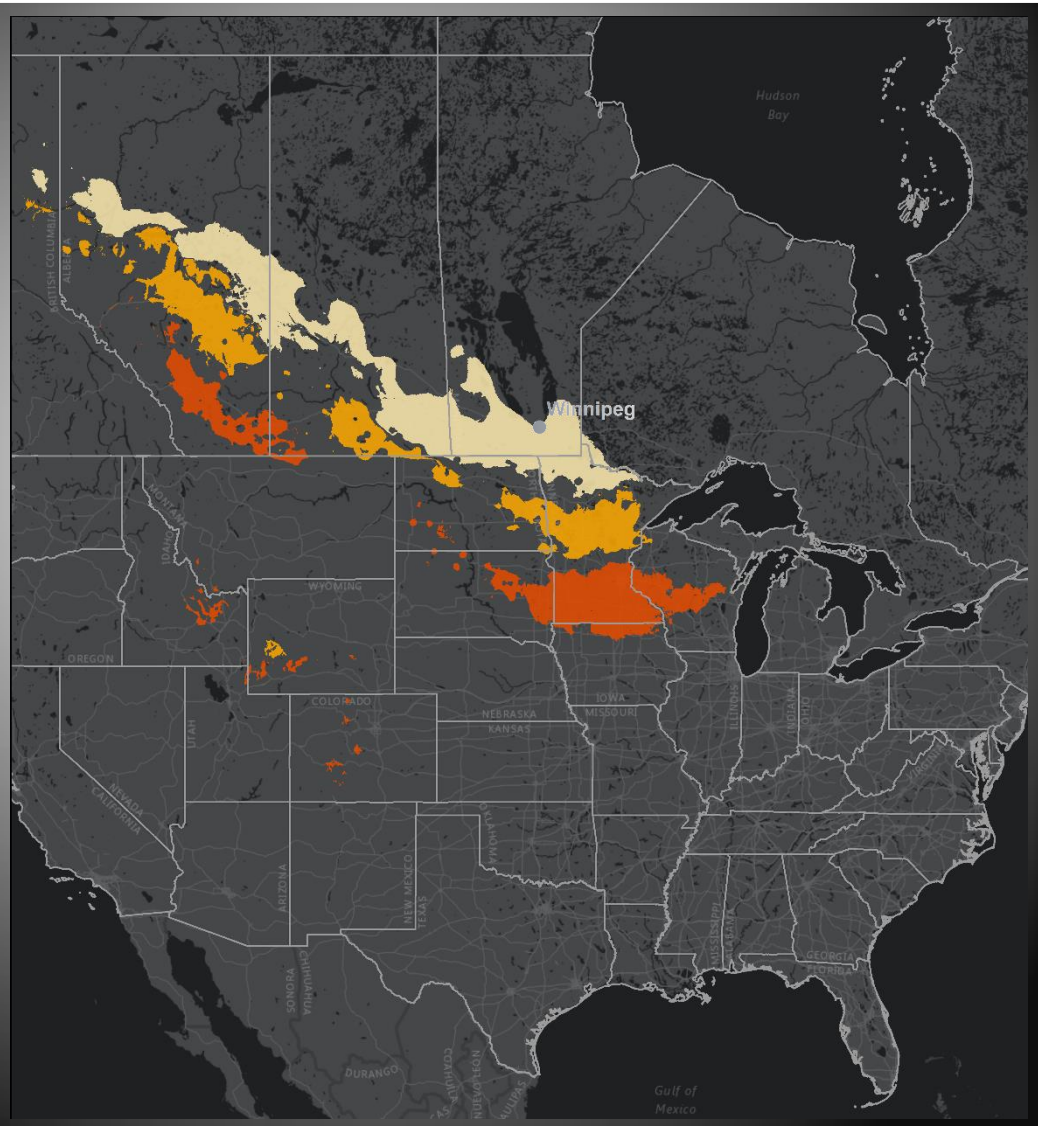


# Winnipeg

*Winter Climate Analogues*

Prairie Climate Centre




Summer

Winter

High Carbon

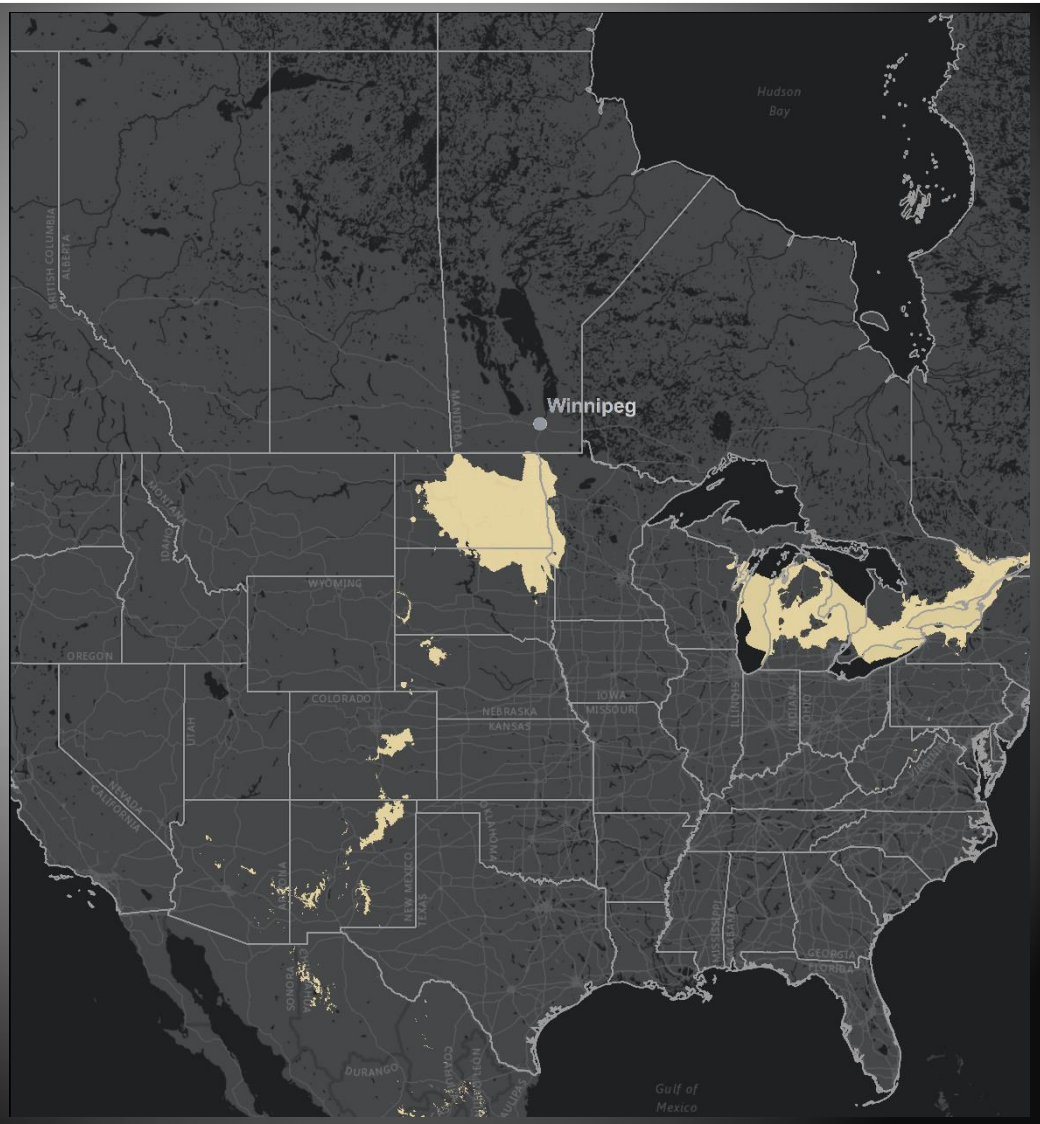
Low Carbon

2020s 2050s 2080s

# Winnipeg

*Summer Climate Analogues*

Prairie Climate Centre




Summer

Winter

High Carbon

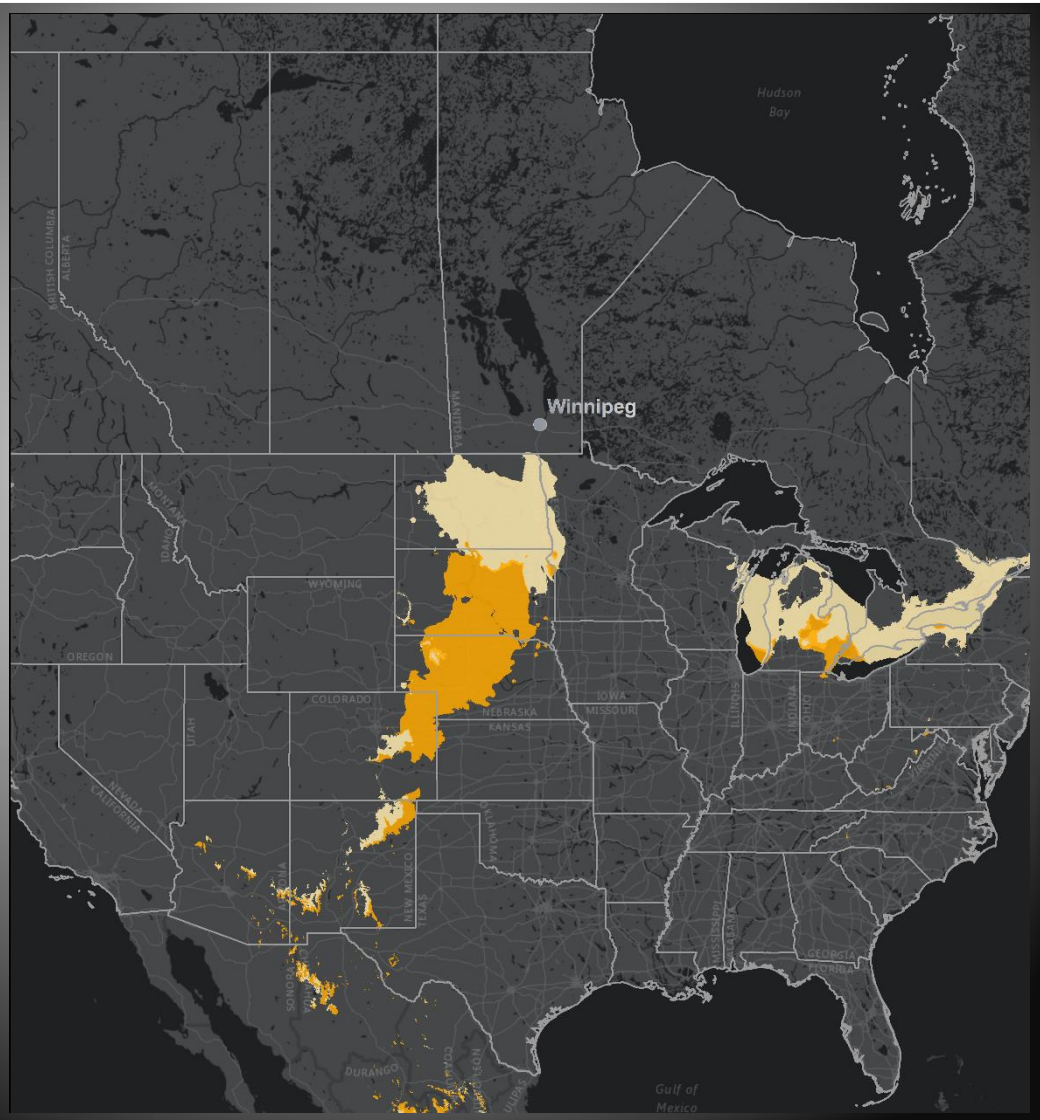
Low Carbon

2020s 2050s 2080s

# Winnipeg

*Summer Climate Analogues*

Prairie Climate Centre




Summer

Winter

High Carbon

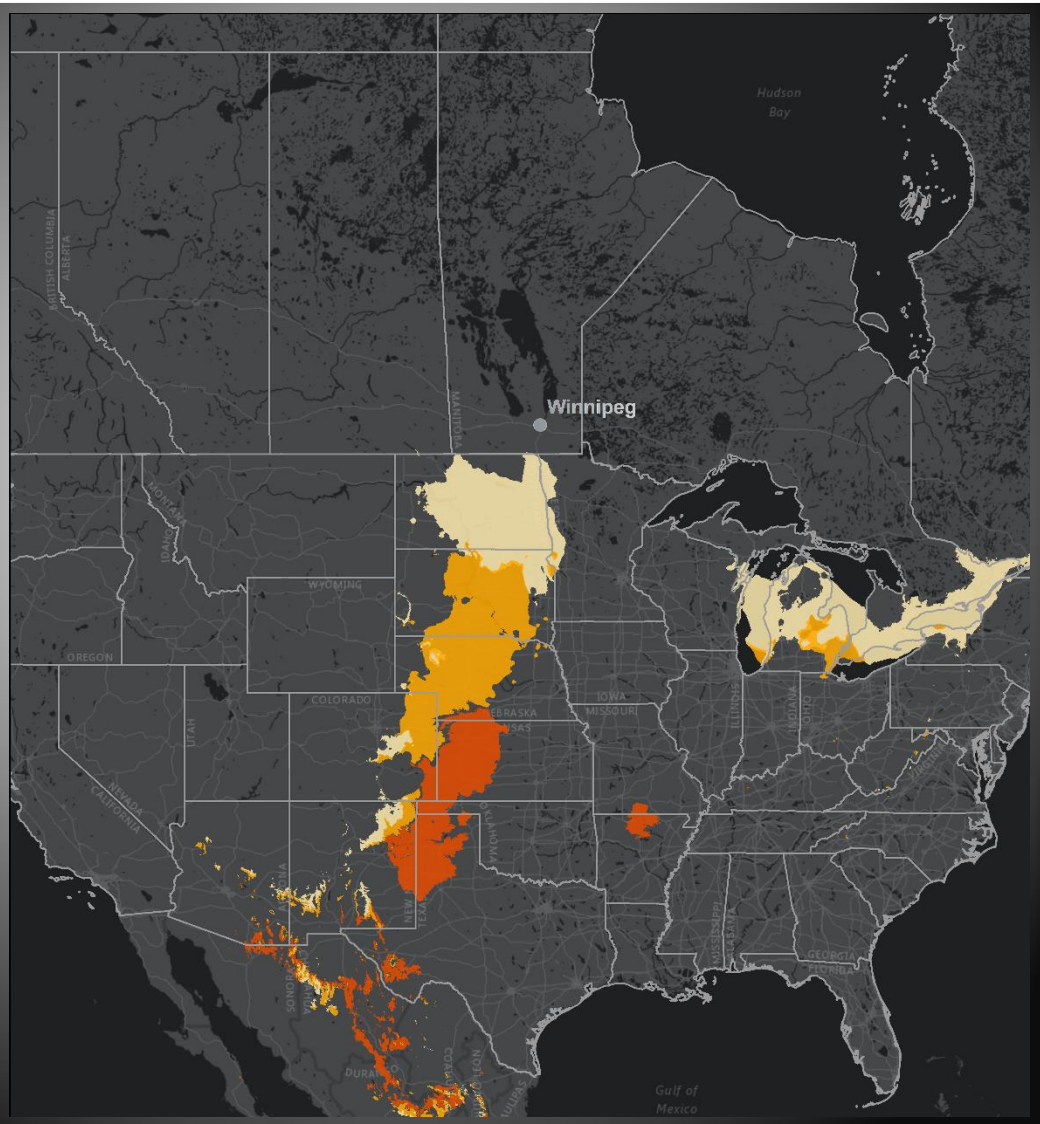
Low Carbon

2020s 2050s 2080s

# Winnipeg

*Summer Climate Analogues*

Prairie Climate Centre




Summer

Winter

High Carbon

Low Carbon

2020s 2050s 2080s

# References

Prairie Climate Centre

BCSD-downscaled climate data supplied by:

Pacific Climate Impacts Consortium, University of Victoria, (Jan. 2015). Statistically Downscaled Climate Scenarios. Downloaded from *pacificcliamte.org*

*THANK YOU PCIC!*

AdaptWest Project. 2015. Gridded current and projected climate data for North America at 1km resolution, interpolated using the ClimateNA v5.10 software (T. Wang et al., 2015). Available at *adaptwest.databasin.org*

# Implications

Prairie Climate Centre

- Shifting seasons
- Shorter, warmer winters
- Longer, hotter summers
- More precipitation in winter, spring, fall
- Less precipitation in summer
- More intense precipitation events
- More severe weather
- More heat waves
- A less stable climate

# Risks

Prairie Climate Centre

- Floods and droughts
- Water resource management
- Human health
- Crop failure
- Invasive species
- Forest fires
- Winter roads
- Infrastructure and building codes
- Disaster management and response
- Summer energy demand

# Benefits

Prairie Climate Centre

- Longer growing season
- New crop varieties
- Lower winter heating costs
- Fewer extreme cold events

# Job #2
# Prairie Climate Centre
# Strategic Plan Development

---

Prairie
Climate Centre

# Strategic Plan Components

- Extensive Consultations with Government, NGO and Government stakeholders
- External Review of other Climate Centres
- SWOT analysis

Prairie Climate Centre

# Strategic Plan Insights

- ***Centres to emulate:***
  - *British Columbia:* Pacific Institute for Climate Solutions (PICS)
  - *Germany:* Potsdam Institute for Climate Impacts Research
  - *Quebec:* Ouranos

Prairie Climate Centre

# Strategic Plan Insights

- ***Unique Niche:***

  *Synergies between Mitigation and Adaptation*
- ***Priority Sectors:***
  - *Agriculture*
  - *Water*
  - *Health*
  - *Emergency Measures (Risk Assessment)*
  - *Aboriginal and Northern Affairs*

Prairie Climate Centre

# Job #3
# Prairie Climate Centre
# focus area: agriculture and water

---

Prairie
Climate Centre

# Applications for Discussion

Prairie Climate Centre

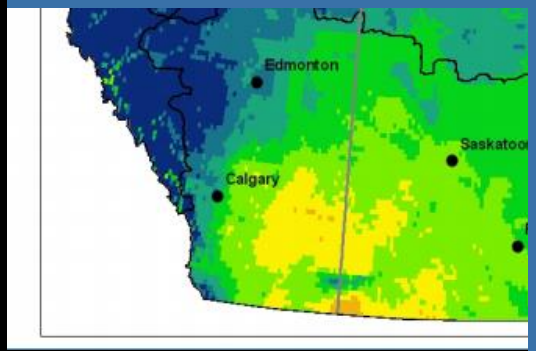
- Stochastic Yield modelling
- Extreme events and thresholds, crop choice, breeding, spatial systems
- Agricultural water management

# Stochastic Yield Modelling

Prairie Climate Centre

## Limitations to the findings…

- Seasonal and inter-seasonal variability in 30 yr. average monthly climate data was not considered.
- Precipitation will be spa
  – improvements in prec
- Findings do not identify (quantity or quality).
- Assumptions and limita
  – e.g. based on current agric





## Implications…

- Adaptive strategy based on farmers seeding earlier.
- With harvest occurring earlier – may lead to future need for fall cover crops on prairies to protect against soil erosion.
- Aridity will still remain a factor in prairie agriculture – droughts are still expected to occur.

# Benefits

Prairie Climate Centre

Theor Appl Climatol
DOI 10.1007/s00704-015-1378-1

ORIGINAL PAPER

## Projecting yield changes of spring wheat under future climate scenarios on the Canadian Prairies

**Budong Qian · Reinder De Jong · Ted Huffman · Hong Wang · Jingyi Yang**

Received: 31 July 2013 / Accepted: 3 January 20


B. Qian (✉) · R. De Jong · T. Huffman
Eastern Cereal and Oilseed Research Centre, Science and Technology Branch, Agriculture and Agri-Food Canada, Ottawa, Ontario, Canada
e-mail: Budong.Qian@agr.gc.ca

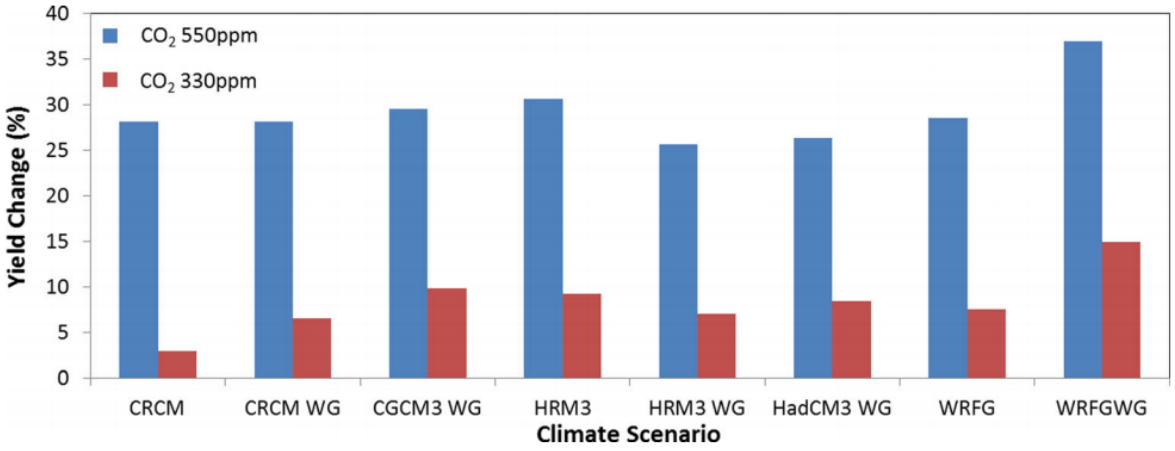
H. Wang
Semiarid Prairie Agricultural Research Centre, Agriculture and Agri-Food Canada, Swift Current, Saskatchewan, Canada

J. Yang
Greenhouse and Processing Crops Research Centre, Agriculture and Agri-Food Canada, Harrow, Ontario, Canada

# Stochastic Yield Modelling

Prairie Climate Centre

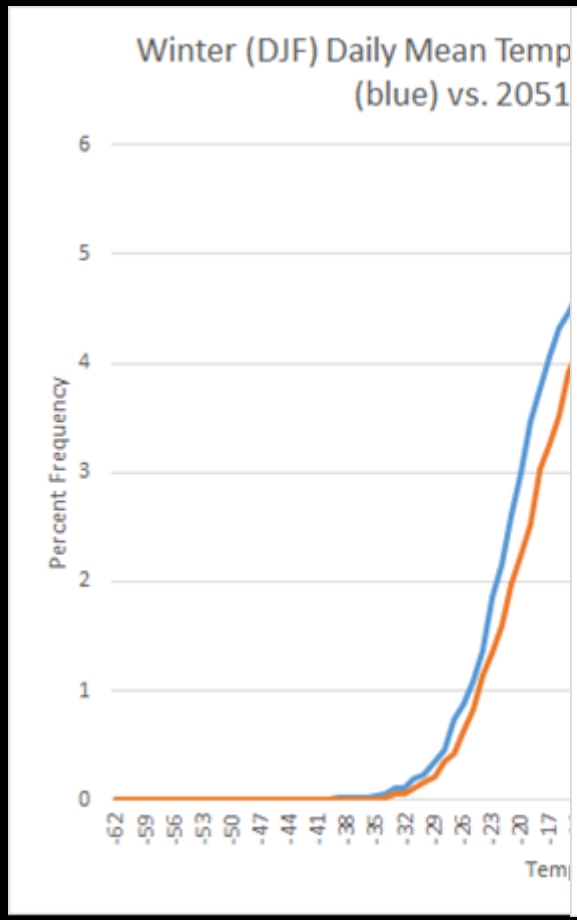
**Fig. 2** Projected spring wheat yield change (%) of 2041–2070 relative to 1971–2000 means averaged from 11 locations across the Canadian Prairies under eight climate scenarios with the elevated $CO_2$ effects (550 ppm) and without the elevated $CO_2$ effects (330 ppm)

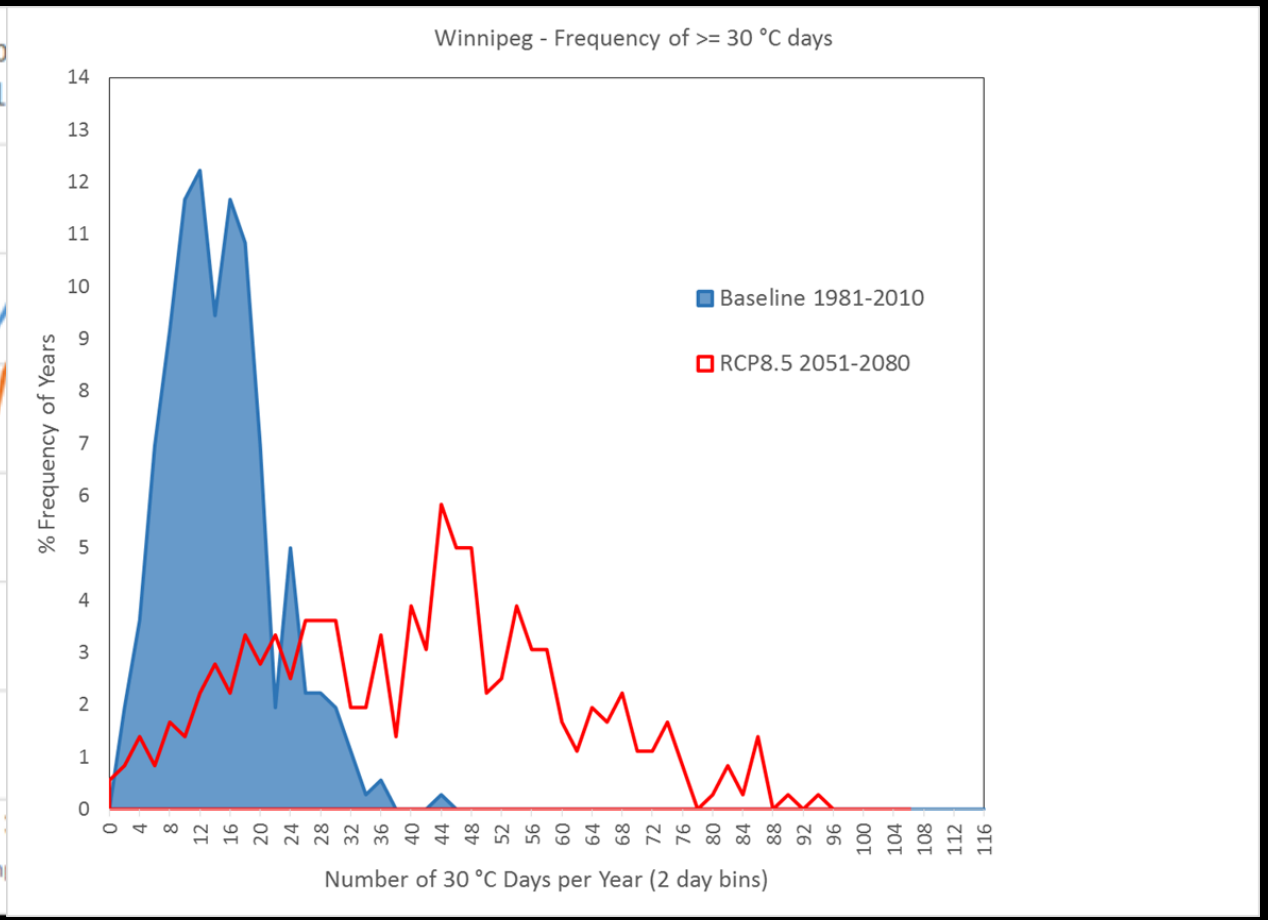



- Strong response to CO2 fertilization
- “yield increase could be overestimated because crop models did not often simulate the effects of heat stress properly.”
- Deryng et al. (2014) projected a wheat yield decrease in Canada because of the projected heat stress under future warmer climates.
- assumption that heat and drought resistant cultivars will be developed

# extreme events and thresholds

Prairie Climate Centre



# extreme events and thresholds

Prairie Climate Centre

*Table 1. This table shows the cardinal base- and optimum-temperatures (°C) for vegetative development and reproductive development, the optimum temperature for vegetative biomass, the optimum temperature for maximum grain yield, and the failure (ceiling) temperature at which grain yield fails to zero yield, for economically important crops. The optimum temperatures for vegetative production, reproductive (grain) yield, and failure point temperatures represent mean temperatures from studies where diurnal temperature range was up to 10°C.*

| Crop | Base Temperature Vegetation | Optimal Temperature Vegetation | Base Temperature Reproduction | Optimal Temperature Reproduction | Optimal Temperature Range Vegetative Production | Optimal Temperature Range Reproduction Yield | Failure Temperature Reproduction Yield |
|---|---|---|---|---|---|---|---|
| Corn | 8[1] | 34[1] | 8[1] | 34[1] | | 18-22[2] | 35[3] |
| Sorghum | 8[16] | 34[16] | 8[16] | 31[17] | 26-34[18] | 25[17,19] | 35[17] |
| Bean | | | | | 23[28] | 23-24[28,29] | 32[28] |
| Cotton | 14[20] | 37[20] | 14[20] | 28-30[20] | 34[21] | 25-26[22] | 35[23] |
| Peanut | 10[24] | | | | | | |
| Rice | 8[12] | 36[13] | 8[12] | 33[12] | 33[14] | 23-26[13,15] | 35-36[13] |
| Soybean | 7[4] | 30[4] | 6[5] | 26[5] | 25-37[6] | 22-24[6] | 39[7] |
| Wheat | 0[8] | 26[8] | 1[8] | 26[8] | 20-30[9] | 15[10] | 34[11] |

Walthall CL (2012) Climate change and agriculture in the United States: Effects and adaptation. USDA Technical Bulletin 1935:1–186

# *implications*

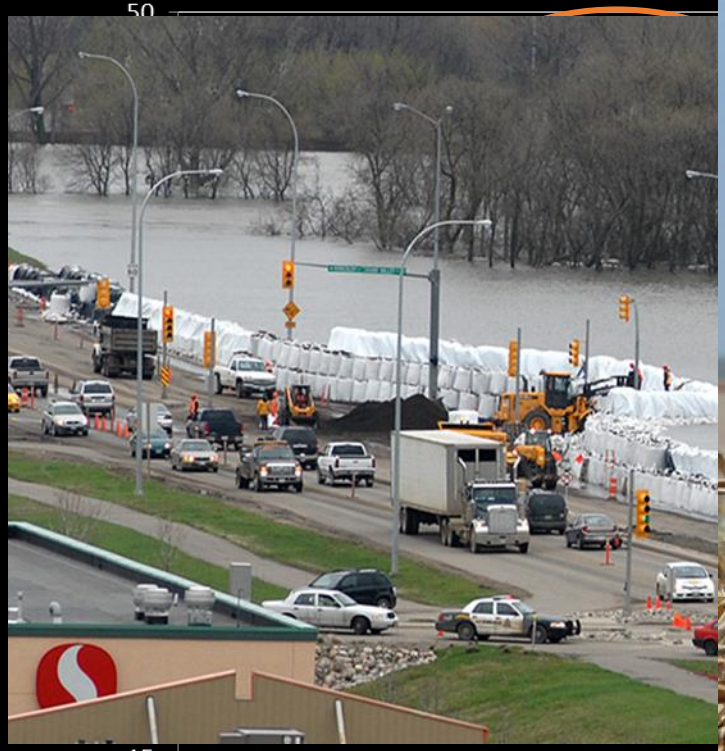
Prairie Climate Centre

Opportunities:

- Full update of suitability analysis with PCIC 12 model ensemble
- Full update of yield analysis with multiple cultivars and “designed cultivars” – DSSAT modelling
- For discussion: use of derived extreme indices for crop breeding objectives

# Agricultural Water Management

Prairie Climate Centre



50

-15

-20

-25

CBCnews | Manitoba

LIVE Manitoba

CBC News Winn

Watch Live

Home | World | Canada | Politics | Business | Health | Arts & Entertainment | Technology & Science | Trending

Canada | Manitoba | Photo Galleries

## Flood, drought, hits Manitoba crop outlook

CBC News Posted: Aug 25, 2011 12:21 PM CT | Last Updated: Aug 25, 2011 12:20 PM CT

0 shares

Facebook

Twitter

Reddit

Google

Share

Email

Manitoba farmers are echoing this week's report by Statistics Canada which predicts a drop in annual grain production.

Doug Chorney, president of Keystone Agriculture Producers said May and June were extremely wet in Manitoba and July and August have been extremely dry.

He said while those who planted crops are seeing lower yields, 2011 has been an economic nightmare for producers who didn't get a crop in due to flooded fields.

"There's weeds that are getting to be three feet tall and that becomes a real management issue for getting that soil ready for next year," Chorney said. "So, not having a crop planted, no income, no crop insurance because you don't have a crop planted makes for a pretty tough season for those farmers."

Stay Connected with CB

Mobile Facebook Podcasts Twit

ADVERTISE

The new CIBC Sm

Monthly fee from $4.95. Capped at $14.95

# Agricultural Water Management

Prairie Climate Centre

Saskatchewan Research Council


Atmosphere-Ocean

Taylor & Francis

Clim Dyn
DOI 10.1007/s00382-012-1422-0

**An assessment of Canadian prairie drought: past, present, and future**

Barrie
Philipp

Received:
© Her M

NOWCAST

ON THE WEB

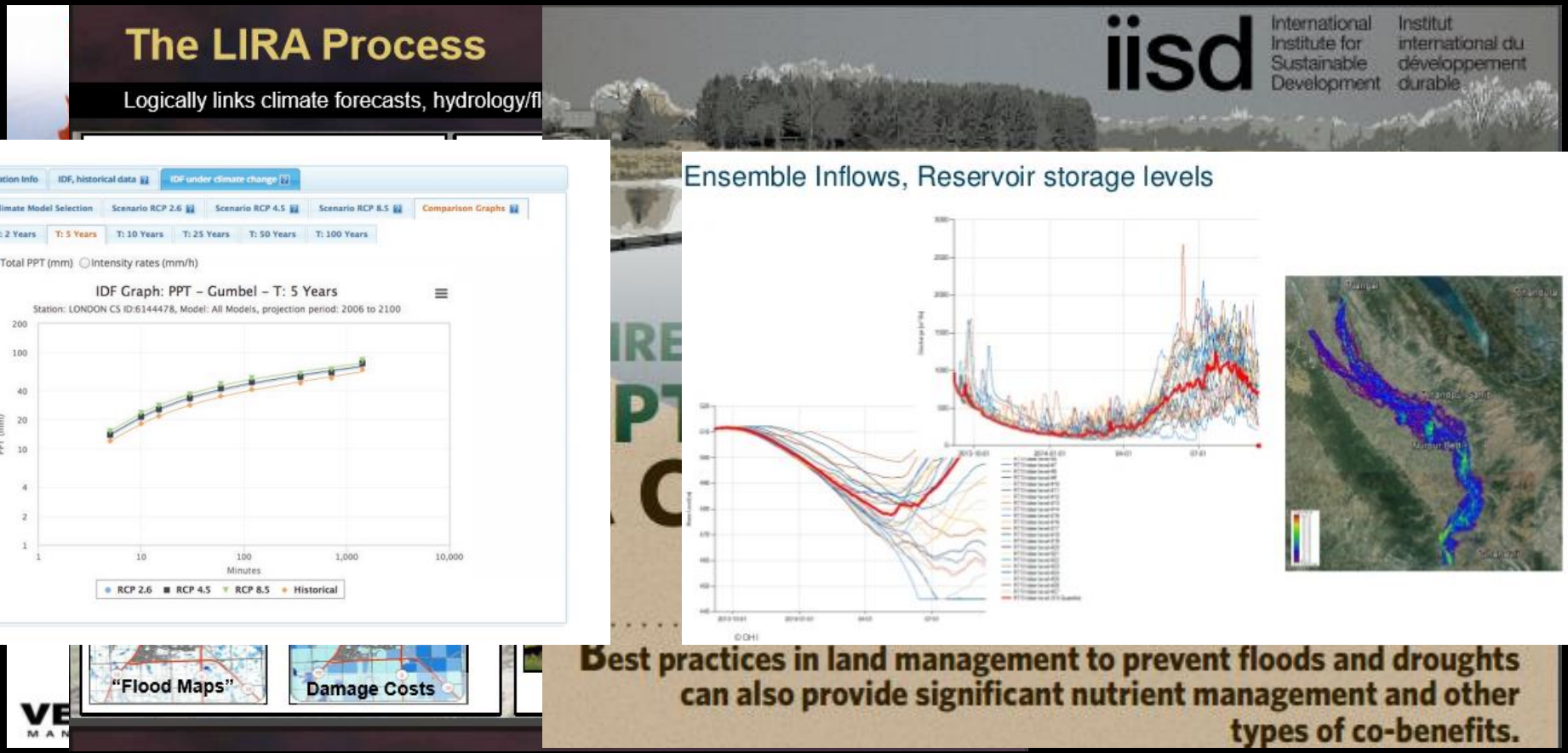
A MULTISCALAR GLOBAL DROUGHT DATASET: THE SPEIBASE

A New Gridded Product for the Analysis of Drought Variability and Impacts

BY SANTIAGO BEGUERÍA, SERGIO M. VICENTE-SERRANO, AND MARTA ANGULO-MARTÍNEZ

# Agricultural Water Management

Prairie Climate Centre

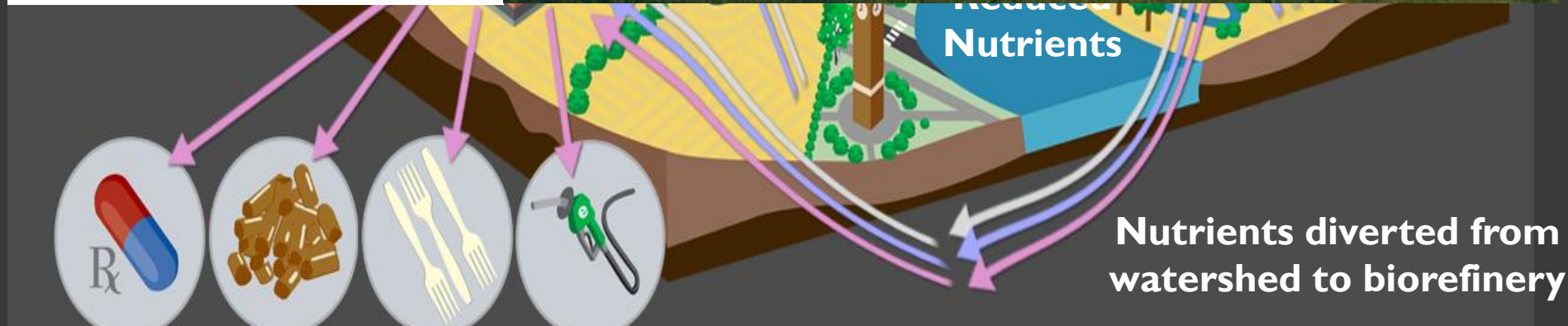



*Green Infrastructure:* Investment case for water harvesting under climate change


ALUS

Alternative Land Use Services

*"Growing a Healthier Environment"*




**Nutrients diverted from watershed to biorefinery**

# Deep Adaptation: meso-scale climate cooling

Prairie Climate Centre

ELSEVIER

Available online at www.sciencedirect.com

ScienceDirect

Agricultural and Forest Meteorology 142 (2007) 234–254

AGRICULTURAL AND FOREST METEOROLOGY

www.elsevier.com/locate/agrformet

## A new paradigm for assessing the role of agriculture in the climate system and in climate change

Roger A. Pielke Sr.[a,*], Jimmy O. Adegoke[b,1], Thomas N. Chase[c,2], Curtis H. Marshall[d,3], Toshihisa Matsui[a,4], Dev Niyogi[e,f,5]

[a] *University of Colorado, CIRES, Boulder, CO 80309, United States*

[b] *Laboratory for Climate Analysis & Modeling (LCAM), Department of Geosciences, 420K Robert H. Flarsheim Hall, 5100 Rockhill Road, University of Missouri-Kansas City, Kansas City, MO 64110-2499, United States*

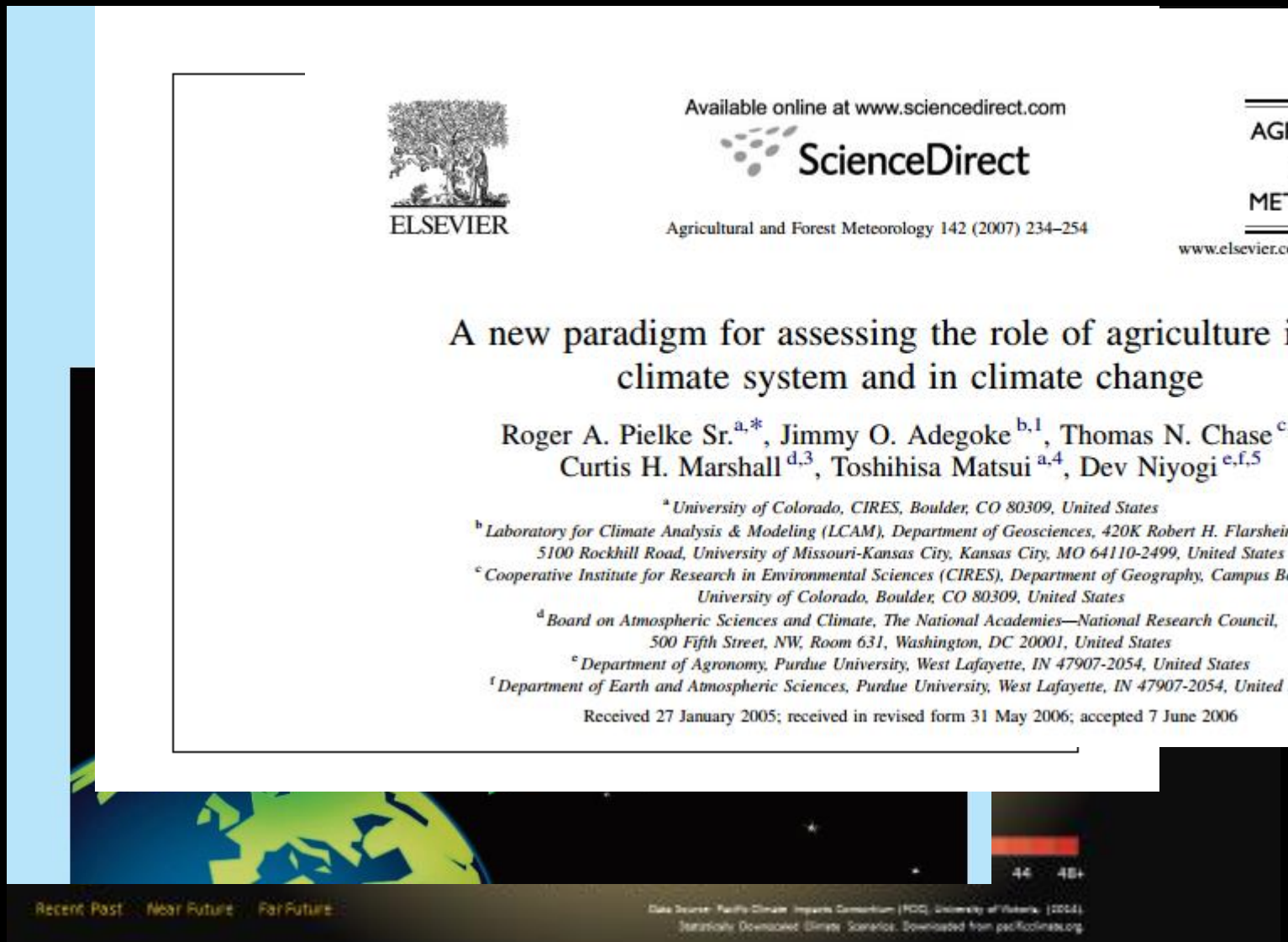
[c] *Cooperative Institute for Research in Environmental Sciences (CIRES), Department of Geography, Campus Box 216, University of Colorado, Boulder, CO 80309, United States*

[d] *Board on Atmospheric Sciences and Climate, The National Academies—National Research Council, 500 Fifth Street, NW, Room 631, Washington, DC 20001, United States*

[e] *Department of Agronomy, Purdue University, West Lafayette, IN 47907-2054, United States*

[f] *Department of Earth and Atmospheric Sciences, Purdue University, West Lafayette, IN 47907-2054, United States*

Received 27 January 2005; received in revised form 31 May 2006; accepted 7 June 2006



# Job #4
# Prairie Climate Centre
# adaptation policy

---

Prairie
Climate Centre

# *Adaptation as Enterprise Risk Management*

Prairie Climate Centre

- *Adaptation tools, processes and best-practices amount to ad hoc extra work for practitioners unless adaptation is fully mainstreamed as core risk management expectation in central policy.*

- *Dedicating the analytical and process effort to adaptation planning requires a "top-level pull", the expectation from executive levels that climate risk management be conducted as a basic feature of departmental programming and budgeting.*

- *Implication: Involve Treasury Board, Department of Finance etc…*